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# USSR Report

EARTH SCIENCES

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10 July 1984

USSR REPORT  
EARTH SCIENCES

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METEOROLOGY

WEATHER MODIFICATION TECHNOLOGY SHOWN AT ALL-UNION EXHIBITION

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 14 Apr 84 p 4

[Article by V. Garov]

[Text] An exhibition which shows how man can control certain natural phenomena, thanks to the achievements of science, has opened in the "Hydrometeorology and Monitoring of the Natural Environment" pavilion of the USSR Exhibition of National Economic Achievements.

This exhibition is called "Active Modification of Hydrometeorological Processes in the Interests of the Economy". With the aid of technology that is being shown here, specialists can prevent hail from falling on grain fields or disperse fog over the runway of an airport, for example. Artificially induced precipitation is being utilized on a broad scale. It brings additional moisture to plants, replenishes reservoirs and extinguishes forest fires.

The exhibition's displays and stands graphically demonstrate, not only the present-day level of such work in our country, but also its future prospects.

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## SCIENTISTS REPORT RESULTS OF STUDIES OF NUCLEAR WEAPONS' CLIMATIC EFFECTS

Alma-Ata KAZAKHSTANSKAYA PRAVDA in Russian 24 Feb 84 p 3

[Text] The effects of nuclear weapons on the Earth's climate would entail long-term consequences which would prove to be no less catastrophic than these weapons' initial destructive factors. Soviet scientists reached this conclusion as a result of studies conducted at the USSR Academy of Sciences' Institute of Atmospheric Physics and its computer center.

At a meeting with journalists in the presidium of the USSR Academy of Sciences on February 22, researchers told how this highly complex theoretical work was carried out at the initiative of the Committee of Soviet Scientists for the Defense of Peace and Against the Nuclear Threat. G. Golitsyn, a corresponding member of the academy, Doctor of Physical-Mathematical Sciences S. Kapitsa and other scientists who spoke at the meeting reported that the planet's atmosphere would become loaded with enormous clouds of dust and products of combustion as a result of nuclear explosions. Over the continents, the temperature would quickly drop below freezing for many months as a result of this. The 'nuclear winter' could not be escaped even during the summer period.

American specialists also have reached an identical conclusion, using another method of calculations. Participants in the meeting emphasized that all honest-minded scientists have the duty of doing everything they can to present to humanity the truth about nuclear war and remove the danger of these lethal weapons.

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SOCIALIST-BLOC CONFERENCE ON CLIMATE FORECASTING

Riga SOVFTSKAYA LATVIYA in Russian 28 Mar 84 p 2

[Excerpt] Kiev, March 27--In the next century the temperature on the planet will become one and a half to two degrees warmer, which may cause appreciable changes in nature. How to predict more accurately changes in the climate of the European continent and problems related to these changes--this is the subject of an international symposium that opened yesterday in Kiev. Taking part in it together with Soviet scientists are their colleagues from Bulgaria, Hungary, the German Democratic Republic, and Poland.

"The planet's climate has become very capricious lately," related Doctor of Geographic Sciences L. Sakali, Deputy Director of the Ukrainian Regional Scientific Research Institute of the USSR State Committee for Hydrometeorology and Monitoring of the Natural Environment. Many researchers believe that one of the chief reasons of unexpected weather extremes is human activity. For example, due to the ever-increasing number of industrial enterprises, the Earth's ozone layer is being damaged, and more and more thermal emissions and carbon dioxide are entering the atmosphere.

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METHODOLOGICAL PROBLEMS IN EVALUATING AND PREDICTING WATER-ICE RESOURCES IN MOUNTAINOUS AREAS

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 5: GEOGRAFIYA in Russian  
No 1, Jan-Feb 84 (manuscript received 7 May 82) pp 39-44

ZHUK, V. A. and PYLEV, I. V., Moscow University

[Abstract] The authors give a review of methods for evaluation of water-ice resources and formulation of adequate models of their formation, computation and prediction. The methodological aspects of these problems are examined. The computation methods can be divided into several groups on the basis of the period of averaging of the computed (predicted) parameter. These methods include the following: methods intended for computations of runoff during a period less than the mean time of water exchange in the investigated watershed; methods for computing runoff during a period commensurable with and greater than the mean time of water exchange; computations and predictions of intra-annual distribution of runoff; computations and predictions of annual runoff and mass balance of glaciers; superlong-range (tens of years or more) predictions of water-ice resources. Each of these is discussed in detail. Among the subjects discussed are: computation of the fields of genetic components of runoff by the expansion of these fields and the fields of meteorological elements in natural orthogonal components; conversion from computations of river runoff field to computations of runoff at a point in the absence of actual observations (or with only short observation series); prediction of runoff components by linear extrapolation method; computation and prediction of mass balance of glaciers in a watershed; direct computations of mass balance components using data from network meteorological stations; factors governing superlong-range forecasts. Figures 1; references: 10 Russian.  
[74-5303]

NEW FACTS CONCERNING DESSICATION OF CENTRAL ASIA

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 5: GEOGRAFIYA in Russian  
No 1, Jan-Feb 84 (manuscript received 2 Jun 83) pp 51-58

VARUSHCHENKO, S. I., Moscow University

[Abstract] It has been projected that in the first half of the coming century the average temperature can change from  $\pm 0.5$  to  $\pm 2^{\circ}\text{C}$  as a result of anthropogenic intervention. It is highly important to evaluate what effect this might have on the climate of Central Asia and Western Kazakhstan, where the water deficit is constantly increasing. Since it is known that mean annual air temperatures have changed approximately in this range in the last 8,000 years, in the past some clues can be sought for the future. In the desert, however, there is little evidence to work with. Fossilized organic remains are few in number and have been subjected to very strong wind erosion, limiting use of the radiocarbon method, palynological and paleontological methods. The paucity of paleogeographic data for the area makes difficult a tie-in of climatic events of the past occurring in Europe and Central Asia and casts doubt on the correctness of different types of forecasts. A new research program has been undertaken directed to the search for archeological objects, determination of their age and relationship to ancient water sources. The frequency of occurrence of such objects is regarded as an indirect indicator of change in moistening of the desert in the past. Ancient horizons naturally enriched with organic matter have been subjected to spore-pollen analysis for climatic reconstructions. This and other types of work involved land and helicopter runs with a total length of more than 10,000 km, large-scale geomorphological surveys and many excavations. A great many new monuments were discovered dating from the Neolithic to the Middle Ages. It was confirmed that the climate of Central Asia periodically becomes moister. With respect to the Holocene, this moistening probably increased primarily due to the falling of cold season precipitation. The increase in the quantity of winter precipitation was a result of disruption of stationarity of the Siberian anticyclone. It is clear that models of climate of the future formulated by physicomathematical methods must be checked against paleogeographic data. There is need for explaining why actual data on the past nature of Central Asia do not agree with the theoretical data assuming an increase in dryness from the middle latitudes to the subtropics in the case of a global warming, not vice versa, as was actually the case in the Middle Ages. Future forecasts are dependent on the correctness of solution of this problem. Therefore, if the climatic tendencies of the Middle Ages are repeated and if predictions of warming of climate in the northern hemisphere by at least  $0.5^{\circ}\text{--}1.0^{\circ}$  in the coming decades are correct, changes in the annual variation of precipitation can be expected in the western parts of Central Asia and Kazakhstan, an increase in the winter component. However, with a decrease in temperature aridity will persist or even increase. Figures 2; references 22: 19 Russian, 3 Western.

[74-5303]

ANALYTICAL MODEL OF LATITUDINAL VARIATION OF DISPERSION AND SPECTRA OF FLUCTUATIONS OF ZONALLY AVERAGED SURFACE TEMPERATURE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 2, Feb 84 (manuscript received 4 Nov 82, after revision 2 Jun 83)  
pp 144-150

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[Abstract] The variability of most climatic characteristics experiences considerable latitudinal variation, usually increasing from the low to the high latitudes. V. Ye. Prival'skiy (IZV. AN SSSR: FAO, Vol 17, No 10, pp 1011-1021, 1981) and K. Ya. Vinnikov, et al. (METEOROLOGIYA I GIDROLOGIYA, No 6, pp 5-17, 1980), in processing series of the secular variation of middle-latitude surface air temperature values, demonstrated that in the high latitudes the standard deviations of these series are 5-6 times greater than in the low latitudes. Several mechanisms possibly responsible for this phenomenon have been proposed. K. Hasselman (TELLUS, Vol 28, No 6, 1976) postulated that long-period climatic fluctuations constitute a response of the inertial links in the system to short-period weather disturbances. The author has here made an analytical investigation of the latitude variation of the intensity of low-frequency fluctuations of air surface temperature caused by this mechanism. First, the author has found some approximate solutions of equations for the dispersion of fluctuations of middle latitude temperatures. These are used in examining the influence exerted on the latitudinal variation of dispersion by such factors as the dependence of albedo on temperature, the latitudinal variation of heat capacity and the structure of random heat influxes. A comparison with the results of numerical computations has indicated that these approximate expressions reproduce rather well the precise solutions of the initial equations. Using this model it was possible to estimate the standard deviations and spectra of year-to-year fluctuations of mean zonal temperatures caused by synoptic fluctuations of the radiation balance. Figures 4; tables 1; references 19: 11 Russian, 8 Western.

[105-5303]

TEMPERATURE RESPONSE OF CRYOSPHERE AREA IN NORTHERN HEMISPHERE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 2, Feb 84 (manuscript received 27 Oct 82, after revision 19 Apr 83)  
pp 136-143

MOKHOV, I. I., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] The response of the area of the cryosphere and its zonally averaged boundary to surface temperature changes is determined on the basis of different empirical data for the northern hemisphere in its annual variation. The

problem is formulated of evaluating the temperature response of extent of the cryosphere, determined by seasonal variations of the area of the snow cover and sea ice, within the limit of seasonal climatic changes. The response of the area of the snow cover is  $-(3.5-5.1)$  million  $\text{km}^2/\text{K}$  and the response of its zonally averaged boundary is  $1.6-2.3$  degree/K. The author compares the estimates of response of the latitude of the snow-ice boundary made on the basis of empirical data (in the annual variation and during Quaternary glaciations) and for climatic models (energy balance and general circulation). As a result of this analysis it was found that the response of the latitude of the cryosphere boundary to the change in surface temperature of the northern hemisphere falls in the range  $2\pm0.5$  degree/K. The shortness of the characteristic inertial time for the total area of the snow-ice cover in the annual variation is explained. It is noted that these findings are applicable to the northern hemisphere only and would be considerably different for the southern hemisphere. Tables 2; references 20: 10 Russian, 10 Western.

[105-5303]

OCEANOGRAPHY

SUBMERSIBLE ROBOT CRAFT 'AKVATOR' DEVELOPED AT SHIPBUILDING INSTITUTE

Kiev PRAVDA UKRAINY in Russian 15 May 84 p 2

[Article by G. Selin (Nikolayev)]

[Text] Through the glass window of a tank, a streamlined object could be seen descending into the water on command from its operator. It was a working model of an unmanned submersible craft, the "Akvator", which is intended for under-water scientific research and emergency-and-rescue work. This craft's original design is the result of creative collaboration between personnel of the Nikolayev Shipbuilding Institute and the Moscow Higher Technical School imeni Bauman. The craft was shown at an exhibition of scientific and technical developments of instructors and students of the shipbuilding institute.

FTD/SNAP  
CSO: 1865/159

RESEARCH SHIP 'AKADEMIK VERNADSKIY' RETURNS FROM ATLANTIC

Kiev PRAVDA UKRAINY in Russian 16 May 84 p 2

[Article by V. Petrenko]

[Text] Last Sunday, May 13, the "Akademik Vernadskiy", a scientific research vessel of the Ukrainian Academy of Sciences, returned to its home port of Sevastopol' from its 28th cruise. Candidate of Technical Sciences N. G. Mikhaylov, Scientific Secretary of the sector on marine expeditionary work of the Ukrainian Academy's Presidium, reported to the editors of PRAVDA UKRAINY that this expedition, which lasted four months, was completed successfully. The scientists--hydrophysicists, geologists and other specialists--conducted comprehensive research in various regions of the tropical Atlantic in the course of the expedition.

FTD/SNAP  
CSO: 1865/159

## COMPUTERIZED HYDROLOGIC RESEARCH COMPLEX 'GIDROZOND'

Moscow VODNYY TRANSPORT in Russian 26 Apr 84 p 3

[Article by P. Volkov, correspondent (Moscow and Obninsk)]

[Abstract] The article provides information on a new computerized hydrologic research complex called "Gidrozond". It was developed at the Central Design Bureau of Hydrometeorological Instrument Building of the USSR State Committee on Hydrometeorology and Monitoring of the Natural Environment. This bureau is located in the Moscow suburb of Obninsk. The "Gidrozond" is said to be on a par with the best foreign models from the standpoint of measurement-error indices, the number of parameters what it can measure, and convenience of operation. It has been included in the State Register of Measuring Equipment and it is being shown in the "Hydrometeorological Service" pavilion of the USSR Exhibition of National Economic Achievements. The "Gidrozond" has been put into series production and is being introduced on a number of research ships.

V. Chub, chief engineer of the bureau commented on practical problems of introducing the "Gidrozond". A. Fokin, the bureau's chief designer, hailed the complex's potential for expanding hydrologic research capabilities. Design project leader Vladimir Pavlovich Gavrilov explained that the "Gidrozond" is intended for measurement of the main parameters of sea water (temperature, pressure and electric conductivity) and for taking water samples at depths as great as 6,000 meters. As compared with conventional bathometer probes, the complex is said to be substantially lighter and more reliable, and it consumes less energy.

The "Gidrozond" consists of a programmed computer, a control console and a submersible device with a bathometric section. The bathometric section consists of 24 bathometers which can take water samples at various depths and at any time, either automatically or on commands from the operator. There is a reserve unit which makes it possible to control the complex in the event of malfunction of the computer. All data from sensors in the submersible device are transmitted by cable to the control console on the mother ship. Results of measurements are shown on digital indicators of the console. They are recorded simultaneously on punch tape and graph plotters. Data on the condition of various assemblies of the submersible device are received simultaneously with the measurement results.

FTD/SNAP  
CSO: 1865/141

## DATA BANK ON PACIFIC AND INDIAN OCEANS

Moscow VODNYY TRANSPORT in Russian 1 May 84 p 4

[Text] Vladivostok--A regional data bank on the Pacific and Indian Oceans has been created at the Institute of Automation and Control Processes of the USSR Academy of Sciences' Far East Research Center. Stored on the computer's magnetic discs is everything that is known about these enormous water stores from 1875 on. Information on changes in the temperature, salinity and chemical composition of ocean waters will now arrive here continuously from research ships. These will be not only Soviet ships, but also foreign ones which are involved in international programs.

The flagship of the Far East research fleet, the research ship "Akademik Korolev", is now conducting trials of a mobile system which is capable of transmitting signals obtained from a multitude of diverse sensors in a form already processed and recorded on magnetic discs.

FTD/SNAP  
CSO: 1865/141

SHIP 'ISSLEDOVATEL' MAKES ATLANTIC CRUISE WITH GEOPHYSICAL RESEARCH EQUIPMENT KNOWN AS 'MARS-2'

Moscow VODNYY TRANSPORT in Russian 17 May 84 p 3

[Article by S. Mel'nikova, (Gelendzhik and Moscow)]

[Abstract] The article is an interview with Gennadiy Nikolayevich Grashkin, head of a recent South Atlantic expedition on the ship "Issledovatel'". The "Issledovatel'", a research ship of the Southern Marine Geology (Yuzhmorgeologiya) Association, is back in its home port of Gelendzhik following the cruise, which lasted six months.

Grashkin relates that the expedition worked in the vicinity of the Angola-Brazil geotraverse. It was the eighth trip here for the ship. Specialists have been testing new apparatus and developing methods for deep-level studies of the structure and movements of the Earth's crust beneath the ocean floor in this area. The crust was probed almost to the very foundation of the continents with the aid of sonic equipment.

Grashkin comments also on features of the "Mars-2", a second-generation navigational-and-geophysical complex which the "Issledovatel'" carries. This complex, which is equipped with two computers, includes a geophysical computer center, navigational-geodetic and geophysical information transmitters, and an integral system for navigation and computerized control of the vessel in accordance with a program, using signals from satellites and navigational systems. The "Mars-2" system allows research to be completely automated and conducted around the clock, according to Grashkin.

FTD/SNAP  
CSO: 1865/151

## UNDERWATER LASER ANEMOMETER FOR MEASURING OCEAN CURRENTS

Moscow NEDELYA in Russian No 15, 9-15 Apr 84 p 5

[Article by K. Zakharov]

[Excerpt] Estonian scientists claim that not just one but several 'storms' at once can be detected in a glass of water. Using laser apparatus, they are able to determine the velocities of extremely slow currents in a liquid. This is important for understanding the mechanism of the origin of underwater eddies in seas and oceans.

A water glass has become a model of a body of water in laboratories of the Estonian Academy of Sciences' Institute of Thermophysics and Electrophysics. Experiments are conducted with a laser Doppler velocity gauge.

There exists a hypothesis that one of the sources of winds is located on the bottom of seas or oceans. There, as a result of the friction of water masses against cliffs and ground, active eddy currents arise. Ascending and affecting the upper layers of water, they cause abrupt temperature fluctuations throughout the body of water, cooling or warming air above the surface, which becomes wind.

"The study of flows of media, especially extremely slow ones, has become possible only with the aid of laser beams," explained candidate of Physical-Mathematical Sciences Arkadiy Rozenshteyn, one of the authors of the development. "This is the only non-contact method of measuring the rate of movement of water masses. Any other instrument which is introduced into the medium being studied is a foreign body and thereby affects the nature of its movement."

Perfected experiments proved suitable for expeditions on the Estonian Academy of Sciences' research ship "Ayu-Dag" in the Baltic Sea. An underwater laser anemometer provided information on phenomena which accompany storms down deep. The results will find application in the solution of problems of environmental protection and weather forecasting.

Moreover, the scientists believe this method has even broader prospects. For example, with a laser it is possible to obtain information on the rate of movement of liquids in vessels and other organs of the human body, or the movement of liquid in stems of plants and in many other objects.

## FLOATING CRANE 'BOGATYR' WITH 500-TON LIFTING CAPACITY

Kiev RABOCHAYA GAZETA in Russian 20 Mar 84 p 2

[Article by V. Volchenko, engineer of the "Sevastopol' Plant imeni Ordzhonikidze" Production Association]

[Excerpt] Performance trials of the "Bogatyr'" a seagoing self-propelled floating crane with a lifting capacity of 500 tons, have been carried out successfully at the "Sevastopol' Plant imeni Ordzhonikidze" Production Association.

This crane is unique. It is equipped with a pivot device that is new in principle. A solid-forged journal-and-thrust roller bearing 7.5 meters in diameter is installed in place of the traditional heavy column with a journal bearing.

Preventing listing during the hoisting of large cargo items in bad weather is one of the most complex problems in crane building. The new floating crane is equipped with a reliable list-control system. The hoisting of cargo on board the crane is controlled by microprocessors. And equilibrium is maintained by powerful pumps which transfer up to 2,000 cubic meters of water an hour to the opposite side of the vessel, into a ballast system.

The group of designers and engineers of the association which took part in the designing and development of the new floating crane has received certificates for 25 inventions. The most significant ones have already been patented in capitalist countries, including Japan.

Chief designer I. D. Goncharenko was among those who worked on the development of the new floating crane.

FTD/SNAP  
CSO: 1865/136

OCEAN POLLUTION REPORTED ON AT SYMPOSIUM ON FINE STRUCTURE AND SYNOPTIC VARIABILITY

Tallinn SOVETSKAYA ESTONIYA in Russian 21 Mar 84 p 3

[Text] Estonian scientists have begun developing models of the transformation of substances, including pollutants, in water and of the movement of these substances in ecosystems of seas and oceans. Monitoring the purity of the Baltic Sea and studying the direct variability of physical and chemical fields of pollution in this closed basin are receiving principal attention in this research. These models are versatile ones, suitable for various regions of the sea.

"The danger of pollution of seas and coastal-shelf areas of the oceans has arisen in connection with increased discharging of wastes from the shore and from vessels," explained Professor A. Aytsam, head of the Baltic Sea Department of the Estonian Academy of Sciences' Institute of Thermophysics and Electrophysics. "It is already well-known that pollutants can accumulate naturally in areas which are remote from the sources of pollution themselves during certain physical phenomena in basins: fronts, synoptic eddy currents, etc. In other words, the concentration of water pollution does not necessarily decrease uniformly as the distance from a source increases. Our task is to learn how to forecast areas of possible concentration of pollutants. And the first stage of this big project will be the modeling and short-term forecasting of the variability, on various scales, of physical-chemical and biological fields of seas and oceans for the purpose of ensuring optimal monitoring of the purity of their waters and of their natural resources."

The Estonian scientists reported on their plans at the second all-union symposium "Fine Structure and Synoptic Variability of Seas and Oceans", which opened in Tallin on March 20. This symposium is being held in connection with a session of the USSR Academy of Sciences' Department of Oceanology, Atmospheric Physics and Geography.

FTD/SNAP  
CSO: 1865/136

## WEST ATLANTIC CRUISE OF SCIENTIFIC SHIP 'KURCHATOV'

Moscow VODNYY TRANSPORT in Russian 5 Apr 84 p 4

[Article by Yu. Shishkov, Candidate of Geographic Sciences, head of the expedition on board the ship "Akademik Kurchatov"]

[Text] (Radio report)--The scientific ship "Akademik Kurchatov" has been plowing the rough waters of the winter Atlantic for more than two months. New studies were carried out in the vicinity of the gulf stream current, to the north of the Bermuda Islands. The expedition of the Institute of Oceanology imeni Shirshov has encountered frequent storms which have been severe and prolonged.

In line with the program "Razrezy" (cross-sections), we have completed another in a series of systematic and comprehensive studies of one of the ocean's energy-active zones. This program's theoretical principles were formulated by academician G. Marchuk. It calls for improvement of methods of forecasting weather and changes of the climate of the European territory of the Soviet Union, and it will promote the solution of important scientific problems, as well as the further development of merchant shipping.

Materials have been obtained on the nature of short-term changes in heat conditions of the ocean and the atmosphere, and on large-scale interactions between them. We are able to compare data gathered during different periods of the cruise of the "Akademik Kurchatov".

A group of colleagues from the Belford Institute of Oceanology (Dartmouth, Canada) made a special trip to meet the Soviet scientists in the Canadian port of St. John's. A meeting also took place with associates of an institute in Newfoundland which is engaged in the study of cold seas. We were familiarized with the main directions of this institute's work: its laboratories; the instruments it uses; and its expeditionary ship, the "Hudson". We and the Canadian specialists took part in the work of a scientific seminar.

After we left the study area in the vicinity of the gulf stream, Captain V. Kasatkin set a course for Havana. Here we were joined by scientists of the Republic of Cuba, with whom joint research was conducted in the Atlantic Ocean, in line with an expanded program.

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CSO: 1865/136

## OCEANOLOGIC STUDIES FROM SHIP 'SHTOKMAN' IN MEDITERRANEAN AND BLACK SEAS

Moscow VODNYY TRANSPORT in Russian 14 Apr 84 p 4

[Article by V. Paka, Candidate of Technical Sciences, head of the expedition on board the ship "Professor Shtokman"]

[Abstract] The author reports on results of a recent cruise of the scientific ship "Professor Shtokman" of the Institute of Oceanology imeni Shirshov. Participants in this cruise studied features of the formation of winter hydrologic conditions in certain areas of the Black and Mediterranean Seas.

The author relates that one of the cruise's objectives was to test a hypothesis of Doctor of Geographic Sciences I. Ovchinnikov, a participant in the expedition. According to this hypothesis, uneven cooling of water masses in seas and oceans takes place during the wintertime, through the action of large cyclonic circulations which raise colder waters from deep levels to the surface in the central parts of these rotating masses. For the purpose of testing this hypothesis, detailed hydrologic surveys were performed in certain cyclonically rotating masses of the Aegean Sea, and two cross sections were made at different times while the ship passed in opposite directions through the center of a rotating mass in the eastern half of the Black Sea.

Studies were made of the vertical structure of hydrophysical fields of the Strait of Tunis, which lies between Sicily and the north coast of Africa. The author explains that this was done for the purpose of quantitatively evaluating characteristics of water exchange between the eastern and western Mediterranean, which occurs in the strait. These studies were made using instruments which specialists of the Oceanology Institute's Atlantic Branch in Kaliningrad developed and produced. These instruments included high-precision probes which register water characteristics in the free-submergence mode, towed systems, and devices for measuring currents. Two onboard computers with several dozen programs for processing results of such investigations were used for monitoring the data-collection operations and analyzing the results.

FTD/SNAP  
CSO: 1865/136

## INSTRUMENTS WATCH OCEAN

Moscow TASS in Russian 0955 GMT 26 Apr 84

[TASS Summary]

[Text] An automatic control system for watching the environment is being created at a special instrument building design bureau which has operated for more than 15 years in the town of Obninsk, in the Moscow area. It includes apparatus for carrying out various observations of natural phenomena, including those at sea, which can be called the "weather kitchen."

One of the latest technical achievements in Obninsk is the "Gidrozond" (hydroprobe)--a hydrological complex which is accepted for serial production.

The newspaper VODNYY TRANSPORT (WATER TRANSPORT) reports today that the "Gidrozond" complex includes a programmed computer, which considerably lightens the work of researchers. It is designed for the automatic measurement of the basic parameters of the sea--temperature, electrical conductivity and pressure, as well as for a selection of water samples to a depth of up to 6,000 meters. All data passes automatically along a cable to the ship for registration and processing.

The "Gidrozond" complexes are now being brought into a number of scientific research ships. In situ tests have confirmed its excellent meteorological and operational characteristics.

CSO: 1865/134

200-MILE MARITIME 'ECONOMIC ZONE' CLAIMED

Moscow IZVESTIYA in Russian 1 Mar 84 p 2

[Abstract] The article announces that the USSR Supreme Soviet has issued a decree, "On the Economic Zone of the USSR", which makes the claim for the country's sovereignty of economic activity in waters of oceans and seas extending 200 miles from the outer limits of Soviet territorial waters. The decree establishes that the USSR has sovereign rights in this zone for purposes of exploration, extraction and preservation of natural resources of the sea, and also management of these resources, and has jurisdiction with respect to the creation and utilization of man-made islands, installations and structures, and to marine scientific research and the protection of the marine environment. The decree does not affect the rights of other states to shipping and air traffic and the laying of underwater cables and pipelines in the economic zone of the USSR, as long as these activities are in compliance with provisions of the decree and other laws of the USSR, and also norms of international law.

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UDC 551.463.5:551.465.41

VARIABILITY OF VERTICAL DISTRIBUTIONS OF SEA WATER TEMPERATURE AND LIGHT  
EXTINCTION INDEX IN SECTION ACROSS MASCARENE RIDGE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 2, Feb 84 (manuscript received 11 Aug 82, after revision 23 Mar 83)  
pp 220-223

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[Abstract] The variability of the vertical structure of oceanological fields in a region with great depth differences was investigated in the southwestern part of the Indian Ocean. During the measurements the ship crossed the Mascarene Ridge; the ship drifted 40 miles, primarily in a west-to-east direction. Simultaneous measurements were made of the vertical distributions of the light extinction index  $\epsilon(z)$  (wavelength  $\lambda = 530$  nm) and temperature  $T(z)$  to a depth of 170-180 m. Measurements were made hourly, each cycle consisting of a series of frequent soundings, an effort being made to exclude the influence of short-period internal waves. Bottom relief in this sector was characterized by three steep scarps; the depth differences were 1,100, 600 and 1,300 m for the three successive scarps. The distribution of light extinction and temperature are shown in Fig. 1. There were two regions with a sharp rise in the isolines for the extinction index and temperature whose position coincides with marked changes in ocean depth. Various reasons are suggested for the distinct changes in temperature and extinction index observed in this short distance. Ocean regions with sharp dropoffs in depth have a complex regime of currents with development of eddy formation processes and wave phenomena, both of which can exert a significant influence on the distribution of oceanological characteristics. The observed distribution may be attributable to the presence of internal waves with quite great spatial-temporal scales and in this region having a great amplitude. There are still other possibilities, but no definite conclusions can be drawn on the basis of data for only a single run. Figures 3; references: 3 Russian.

[105-5303]

UDC 551.465.41

DEVELOPMENT OF UPPER MIXED OCEAN LAYER WITH INCREASE IN STABILITY AND  
IN PRESENCE OF WIND

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 2, Feb 84 (manuscript received 7 Jul 82) pp 213-217

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[Abstract] There is an increase in stability of the upper layer of the ocean when there is intensive solar heating or precipitation falls. Using a one-dimensional integral model, Niiler and Kraus postulated that the mixing layer attains a stationary state when a balance is established between the influx of turbulent energy from the ocean surface and its expenditures on work on the mixing of the lighter fluid and viscous dissipation. It was later found that this picture is not entirely consistent with laboratory observations and for this reason the authors have endeavored to explain this discrepancy. It is shown that one of the possible reasons for the noncorrespondence between model computations and laboratory experiments and in situ observations is the absence in the model and experiment of an additional source of turbulent mixing and entrainment caused by the transformation of the kinetic energy of the mean flow into turbulence due to friction at the lower boundary of the mixed layer. It is shown that the friction effect becomes particularly significant when there is a great stability of the upper mixed layer. A system of three equations with three unknowns is derived whose solution describes the dynamics of the mixed layer when there is an influx of buoyancy and when frictional forces are operative at the free surface. Solution of the system shows that first there is a rapid deepening of the mixed layer to the level predicted by Niiler and Kraus, but in contrast to their findings, this is not a limit. In actuality, the layer develops further due to the transformation of kinetic energy from the mean flow into turbulence which maintains entrainment. This transformation occurs near the lower boundary of the mixed layer. With a great stability of the mixed layer the frictional effects at the lower boundary begin to exert an effect and these limit the increase in mean flow velocity and layer thickness. Figures 1, tables 1; references 8: 2 Russian, 6 Western.

[105-5303]

UDC: 553.52:553.551

SUBALKALINE BASALTIC MAGMATISM OF ACTIVE OCEAN-CONTINENT TRANSITION ZONES

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA in Russian No 3,  
Mar 84 (manuscript received 27 Oct 82) pp 24-41

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[Abstract] The concept of the active zone of transition from ocean to continent includes island arcs, deep-water trenches, marginal seas and marginal-continental mobile belts of the Andes type. This article discusses results of

geological observations of the past 10 to 15 years. Petrologic-geochemical specifics of potassium-sodium subalkaline basaltic magmatic series are discussed. The position of magmatic formations in evolutionary series is noted. The petrology, geochemistry, spatial distribution, structural type and position of magmatic subalkaline active margins of the oceans and continents in evolutionary series indicate their petrologic and geochemical independence and genetic autonomy. The appearance of shoshonitic rock in island arcs and active continental margins only in the late stages of the evolution of magmatism indicates transition of these areas to maturity. Shoshonites arising in any stages of development of marginal areas indicate only the presence of a sialic dome whose contaminating effect begins to be felt immediately after development of subduction zones. K-Na subalkaline basalt magmatism does not serve as an indicator as does shoshonitic magmatism. Shoshonitic and limestone-alkaline magmatism are apparently essentially similar in terms of petrogenesis mechanics. Figures 5; references 65: 16 Russian, 49 Western.

[125-6508]

UDC 552.321.6

#### PERIDOTITES OF THE KHIZEN FAULT (SOUTHEASTERN PACIFIC OCEAN)

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA in Russian No 3, Mar 84 (manuscript received 12 Apr 83) pp 42-53

LAZ'KO, Ye. Ye., KASHINTSEV, G. L., and MURAVITSKAYA, G. N., Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry, Institute of Oceanography, Moscow

[Abstract] The 24th voyage of the Akademik Kurchatov in 1977 included studies long Khizen fault. Geological operations were concentrated on the north side of the fault at  $55^{\circ} 17' S$ ,  $125^{\circ} 39' W$ , some 440 km to the west of the crest of the eastern Pacific rise. At depths of 660 to 5640 m, bottom dredges brought up a sequence of basalts, dolorites, gabbro, peridotites and amphibolites, the peridotites from depths of 3900 to 4950 m. The dredge also brought up fragments of pyroxene-amphibole-plagioclase rock with olivine and phlogopite, arbitrarily classified as granulites. Processing of materials obtained in the area indicated that effusive and intrusive rocks make up a cross section of the oceanic lithosphere which has been subjected to tectonic disjoining after consolidation. It is particularly interesting to see how the complex petrologic-tectonic processes influenced the structure and composition of the peridotites, particularly since they are the first finding of ultrabasites subject to low-temperature modifications in the Pacific. It is emphasized that these peridotites do not differ from their analogs from the Indian and Atlantic Oceans. This emphasizes the similarity of composition of the mantle beneath and mid-oceanic ridges and the similarity of petrogenetic processes in these structures. The peridotites have undergone a complex evolution, the earliest recognizable stage being their diapir upthrust from the upper mantle followed by cooling and subsolidus transformation in the oceanic lithosphere. This was followed by secondary heating by basaltic melts, tectonic movements characteristic for the constructive boundaries of the lithospheric plates and subsequent deformation either beneath the axial line of the mid-ocean ridge or during slipping in a transformed fault zone. Figures 4; references 34: 10 Russian, 24 Western.

[125-6508]

EVALUATING PARAMETERS OF VERTICAL EXCHANGE OF OCEAN WATERS BY RADIOISOTOPIC METHODS

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 2, Feb 84  
(manuscript received 18 Apr 83) pp 3-5

BATRAKOV, G. F., YEREMEYEV, V. N. and ZEMLYANOY, A. D., Marine Hydrophysical Institute, Ukrainian Academy of Sciences, Sevastopol

[Abstract] The vertical transfer of salts, dissolved gases, radioactive isotopes and various impurities occurs due to the vertical component of averaged velocity  $W$  and vertical turbulent diffusion  $K_z$ . Direct measurements of  $W$  and  $K_z$  involve great difficulties. Specialists at the Marine Hydrophysical Institute during 1977-1982 determined  $W$  and  $K_z$  in different regions using the radioactive isotopes  $Rn^{222}$  and  $Cs^{137}$  in sea water. In open regions of the ocean the partial pressure of  $Rn^{222}$  in surface waters is greater than in the atmosphere and as a result there is an  $Rn^{222}$  flux from the ocean into the atmosphere which leads to a considerable concentration gradient in the mixed layer. The  $Rn^{222}$  concentration in sea water is very low and measurement methods have been quite complex. The authors have developed a more advantageous method. It involves the segregation of dissolved gases from a large-volume continuous water flow,  $Rn^{222}$  concentration in charcoal, desorption and measurement of activity in scintillation chambers. The statistical error in sample measurement of  $\pm 10\%$  is ensured in no more than 20 minutes. Measurements of the vertical  $Rn^{222}$  concentration were made on several cruises of the "Mikhail Lomonosov" in the Indian Ocean and in the tropical Atlantic and another vessel with 8-10 determinations being made to depths of 150 m. Some of the profiles reveal an exponential increase in the  $Rn^{222}$  concentration from the surface to the upper boundary of the thermocline and these profiles can be used in evaluating  $K_z$ ; a two-layer model is used in evaluating  $K_z$  in the mixed layer. The results of computations for  $Rn^{222}$  profiles are tabulated.  $Cs^{137}$  can be used in studying vertical transfer in intermediate layers and its concentration was measured during 1977-1980 from the "Mikhail Lomonosov" and "Akademik Vernadskiy." These data were used in evaluating  $W$  and  $K_z$ ; estimates were made for the layer where the concentration dropped off exponentially. The  $K_z$  and  $W$  values computed for different regions of the Atlantic and Indian Oceans are tabulated. Tables 2; references 2: 1 Russian, 1 Western.

[115-5303]

## DENSITY MODEL OF UPPER MANTLE UNDER OCEANS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 2, Feb 84  
(manuscript received 18 Oct 82) pp 103-107

LUKASHEVICH, I. P. and PRISTAVAKINA, Ye. I., Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences

[Abstract] Direct measurements of the depth of the bottom of the lithosphere in the oceans are extremely difficult and indirect measurements are encumbered by ambiguities. The leading researchers in this field have postulated that the oceanic lithosphere is formed due to the crystallization of partially molten matter in the upper mantle during the movement of lithospheric plates from the rift zones to the margins of the ocean. This process can be described by the thermal conductivity equation. However, during the last 20 years there have been about 40 measurements of thickness of the lithosphere by seismic methods or by the placement of bottom seismic stations. Therefore, theoretical and experimental data can now be compared. Such a comparison is made here for those seas and oceans having a depth of more than 5,000 m and an age more than 60 million years. Since bottom seismic stations are the best sources of data, such observations were assigned a weight of 3. Three age intervals were used (0-20 million years, 20-60 million years, >60 million years). The following formulas are derived for thickness of the lithosphere:

$$H_{l1} = 7.5 \sqrt{t}, \sigma = 0.7; n = 7 \text{ (0-20 million years);}$$

$$H_{l2} = 8.8 \sqrt{t-5} (\approx 8.3 \sqrt{t}), \sigma = 0.4; n = 11 \text{ (20-60 million years);}$$

$$H_{l3} = 7.6 \sqrt{t+14} (\approx 8.1 \sqrt{t}), \sigma = 0.3; n = 20 (>60 \text{ million years}).$$

(Here  $t$  is the age of the ocean floor in millions of years,  $n$  is the number of measurements). In addition, expressions are derived for the velocities of longitudinal waves in each of the layers of the lithosphere and asthenosphere. Comparison of all the data indicate that the asthenospheric density values obtained by the authors are close to real. The data indicate an adequacy of the three-layer crystallization model developed by the author (I. P. Lukashevich, OKEANOLOGIYA, Vol 22, No 3, pp 423-430, 1982; Vol 22, No 5, pp 925-991, 1982) for describing upper mantle structure. Figures 3; references 14: 12 Russian, 2 Western.  
[100-5303]

PROGNOSTIC RELATIONSHIPS FOR SURFACE TEMPERATURE ANOMALIES IN NORTHERN PART OF PACIFIC OCEAN

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 274, No 5, Feb 84  
(manuscript received 8 Jun 83) pp 1197-1200

ROGACHEV, K. A., Pacific Ocean Oceanological Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Vladivostok

[Abstract] Ocean surface temperature anomalies (OSTA) are formed in extremal years; they have a clearly expressed seasonal variation. During the period 1950-1982 OSTA attained maximum development toward the end of summer and more than 3/4 of the northern part of the Pacific Ocean (north of 20°N) was occupied for a considerable time by anomalies of the same sign. In extremal years OSTA cause changes in ocean-continent thermal contrasts. The time shift of the autumn transition season is dependent on the degree of the contrast. A positive feedback, which causes development of temperature anomalies in the ocean, is determined by the dependence of the meridional heat flow on the mean meridional temperature gradient. Meridional heat transfer by standing waves has a maximum in the middle latitudes at 120°E where there is a strong transport of cold from the high to the middle latitudes. An increase in the atmospheric temperature gradient between the high and middle latitudes associated with development of positive OSTA results in a weakening of the cold flow to the middle latitudes, weakening of temperature gradients at these latitudes and OSTA intensification. These and other regularities are reproduced in a simple model taking into account the principal climate-forming factors: ocean-continent thermal contrast, meridional thermal gradient and ocean-atmosphere heat exchange. The model describes the mechanism responsible for the time shift of the transition seasons, formation of temperature anomalies in the ocean and their relationship to atmospheric processes. The phase shift between the baroclinic and barotropic wave components determines the meridional heat transfer. The phase shift is related inversely proportionally to the thermal wind. Since atmospheric temperature in the temperate latitudes in this region in the cold season is largely determined by the meridional heat flow, a positive feedback can develop between these parameters. A change in the ocean-continent thermal contrast, due to the nonlinear dynamics of standing waves describing atmospheric centers of action, results in a time shift of the transition seasons. The time shifts of the transition seasons determine the formation or destruction of macroscale temperature anomalies in the ocean.

Figures 2; references 6: 4 Russian, 2 Western.

[96-5303]

UDC 550.838(26)(267)

## CHANGES IN RELATIVE INSTANTANEOUS SPREADING RATES IN INDIAN OCEAN

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 4: GEOLOGIYA in Russian  
No 1, Jan-Feb 84 (manuscript received 11 Mar 83) pp 69-76

GAYNANOV, A. G., SHREYDER, A. A. and Le V'yet Khuen, Moscow University

[Abstract] A generalization of published magnetometric data for the Indian Ocean was used in compiling a map of the axes of paleomagnetic anomalies in a Mercator projection at a scale of 1:5,000,000. In compiling this map the spatial position of the axes of the paleomagnetic anomalies, taken from the literature, was corrected using actual data for geomagnetic surveys and computed profiles, constructed for specific models of spreading of the floor. Details are given concerning map compilation; all the axes of the paleomagnetic anomalies had to be replotted. Interpretation of this map made it possible to define three principal systems of anomalies. The spreading rates were computed using the latest chronological scales (Lowrie-Alvarez for anomalies 1-34, Vogt-Einwich for Mesozoic anomalies). These and other data made it possible to compute the rate between adjacent anomalies (instantaneous rates). Computations of these instantaneous rates were used in constructing histograms of the distribution of rates and the relative errors in determining spreading rates for three systems of paleoanomalies and for all systems of anomalies. A figure shows the distribution of relative instantaneous linear rates with time along different profiles for three systems of paleomagnetic anomalies in the Indian Ocean. Another figure shows the behavior of rates of spreading of the floor along a submeridional profile in the Central Basin. All the maximum rates correspond to onset of rift formation processes which always precede spreading of the ocean floor. A simultaneous analysis of paleogeodynamic reconstructions and rate characteristics of ocean spreading makes it possible to ascertain the duration of the rift formation process, which for the Indian Ocean is about 1-2 million years. Figures 3; references 13: 2 Russian, 11 Western.

[92-5303]

UDC 551.242.2+552.3(265/266)

## TECTONIC AND MAGMATIC ROCK OF CENTRAL PACIFIC OCEAN

Moscow GEOTEKTONIKA in Russian No 2, Mar-Apr 84 (manuscript received 19 Jul 83)  
pp 3-22

PUSHCHAROVSKIY, Yu. M., MELANKHOLINA, Ye. N., SAVEL'YEVA, G. N. and  
RAZNITSIN, Yu. N., Institute of Geology, USSR Academy of Sciences

[Abstract] In 1982 the Institute of Oceanography and the Institute of Geology, USSR Academy of Sciences undertook an expedition on the research vessel Dmitriy Mendeleyev to the central Pacific Ocean in order to reveal suitable areas in fracture zones and by dredging to collect rock samples from specific sections of the crust of the greatest possible thickness. One such section is

located in the western portion of the Clarion Fault, another in the central portion of the Nova Fault, a third in the Magellan Fault to the northeast of the rise of the same name. Interesting rock collections from the second and third layers of the oceanic crust were gathered here, plus ultrabasite specimens from Clarion Fault. Significant information was obtained on the structure of the crust cross sections and rock deformations. This article discusses the results of processing of the collected materials. The distribution of the rocks in the sections indicates that significant tectonic disruptions and displacements have occurred in the oceanic crust. Tectonic and magmatic activity has obviously been intensive in the central Pacific Ocean. Figures 5; references 47: 16 Russian, 31 Western.

[133-6508]

UDC 552.323.6(571.5)

#### FORMATION AND DISTRIBUTION OF KIMBERLITES IN THE EASTERN SIBERIAN PLATFORM IN CONNECTION WITH DEEP STRUCTURE SPECIFICS

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA in Russian No 3, Mar 84 (manuscript received 15 May 82) pp 54-65

GRINSON, A. S., All-Union Scientific Research Institute of Geology, Leningrad

[Abstract] Regional seismic studies in the eastern portion of the Siberian platform in recent years have allowed refinement of existing concepts of the structure of the upper lithosphere in this area. Analysis of the deep structure of this territory allows a better-founded description of the situation of formation and placement of kimberlite diatremes. A comparative study was performed of the structure of the upper lithosphere in the kimberlite provinces of the Siberian Platform. It has been found that the tectonic conditions of ancient continent rift formation are most favorable for the appearance of kimberlite magmatism. Future studies should be directed toward joint interpretation of the petrologic-mineralogic data obtained in the studies of kimberlites and the materials of deep geophysical soundings by various methods.

Figures 2; references: 41 Russian.

[125-6508]

UDC 534.25:551.463.2

#### FEATURES OF SOUND PENETRATION FROM AIR INTO WATER

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 20, No 2, Feb 84 (manuscript received 22 Jul 82, after revision 22 Nov 82) pp 208-210

RAZIN, A. V., Radio Physics Scientific Research Institute

[Abstract] A study was made of the distribution of acoustic pressure in water created by a sound source situated in the air. Solution of the wave equation

was used in the numerical computations. In the formulation of the problem it is assumed that in the air at the height  $h$  over a plane water surface there is a fixed point isotropic harmonic sound source whose radiation is in a homogeneous unbounded medium. First the sound field near the water surface is examined. Computations were made for a source altitude  $h = 0.5 \lambda_1$ , where  $\lambda_1$  is the length of the acoustic wave in the air. At the interface the law of change in the pressure field with distance from the source with a great accuracy coincides with the law  $2/R$ , where  $R = (r^2 + h^2)^{1/2}$ , the difference between them, falls within the limits of several percent. With an increase in the depth of the observation horizon the dependence of the amplitude of acoustic pressure on distance becomes oscillating. The value of these oscillations is maximum at a depth equal to half the length of the acoustic wave  $\lambda_1$  in the air. With a further increase in depth the intensity of the oscillations decreases, whereas at depths exceeding  $\lambda_1$  the dependence of pressure on distance again becomes monotonic. At source heights  $h = 0.25 \lambda_1$  and  $h = \lambda_1$  the nature of the dependence of amplitude of pressure in the acoustic wave remains the same. With increasing distance of the observation horizon from the water surface the pressure drops off with distance more and more smoothly. As a result, beginning at some distance the acoustic field can increase with depth. The presence of oscillations in the dependence of the amplitude of acoustic pressure on horizontal distance and the possible increase in acoustic pressure with depth are explained qualitatively. It is shown that for the selected heights of the sound source and depths of the observation horizons the geometrical acoustics approximation would lead to incorrect results. Figures 3; references 7: 1 Russian, 6 Western.

[105-5303]

UDC 551.551.8:551.513.11

#### MODELING KINETICS OF AERODISPERSE PHASE IN OCEAN SURFACE LAYER

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 2, Feb 84 (manuscript received 26 Jul 82) pp 192-198

BORISENKO, Ye. P. and KUZNETSOV, M. A., Main Geophysical Observatory

[Abstract] Modeling of the kinetics of the aerodisperse phase in the ocean surface layer was undertaken. At the time of moderate and storm winds the upper layer of the ocean is saturated by great numbers of air bubbles. These are formed as a result of the collapse of wave crests and upon attaining the water surface they are responsible for the formation of spray. The role of the aerodisperse phase goes beyond this, since the two-phase nature of the water surface layer exerts an influence on its physicochemical properties and on the intensity of gas exchange and determines a number of acoustic phenomena. In solving these problems the structure and kinetics of the aerodisperse phase constitute the initial information and accordingly it should be described in analytical rather than in numerical form. The basis of the formulated model is the assumption that in the case of well-developed waves there is a quasi-stationary field of air bubbles in the water. It is further assumed that if

it is possible to introduce some parameter  $t$  characterizing the mean time from one collapse of a wave at a particular point to the next, the field of air bubbles in the water can be described by a distribution function in the form  $\Phi(D, z, t)$ . In connection with formulation of the model a hypothesis of formation of a two-phase surface layer is presented. All the data presented here indicate that the model satisfactorily describes the principal regularities in the structure and kinetics of the aerodisperse layer. However, many of the assumptions arising in solving this problem require further careful checking. The dependence of the model relationships on wind velocity warrant special discussion. It appears that the mechanism of formation of the aerodisperse phase does not change its nature with an increase in wind but only increases its intensity. The influence of the wind must be manifested primarily in the integral characteristics, in an increase in the density of the flux of bubbles without a change in its differential structure. Figures 3; references 16: 15 Russian, 1 Western.

[105-5303]

TERRESTRIAL GEOPHYSICS

TSUNAMI WARNING SYSTEM DISCUSSED AT SEISMOLOGISTS' MEETING

Moscow IZVESTIYA in Russian 25 Apr 84 p 3

[Article by A. Pushkar', correspondent (Yuzhno-Sakhalinsk)]

[Text] A meeting of seismologists of the USSR Academy of Sciences' Far East Research Center (DVNTS) has been held in Yuzhno-Sakhalinsk. Taking part in this meeting were 130 specialists who have drafted a plan of work on preventing destructive consequences of earthquakes and tsunamis--gigantic waves caused by earthquakes.

DVNTS' Institute of Marine Geology and Geophysics has found that more than half of all the earthquakes which occur each year in our country originate in the Kuril-Kamchatka zone, approximately 100 kilometers to the east of the Kuril Islands. From time to time, these earthquakes give rise to immense waves as high as 8 meters, which crash on the coast. This is why specialists are intensely studying this threatening phenomenon of nature.

The scientists told about new projects aimed at heightening the reliability of earthquake forecasting. These projects call for the use of satellites, the deployment in the ocean of buoys equipped with hydrophysical instruments and radio transmitters, and remote recording equipment installed on the ocean floor. Research of biological precursor phenomena of tsunamis is in progress and tsunamis' effects on shore installations are being modeled in the institute's hydromechanics laboratory. In combination with automated information gathering, these new methods will permit the organization of a unified high-precision, high-speed tsunami warning system for the whole Far East by 1990.

A seismic zoning map of Sakhalin and the Kuril Islands has been compiled which indicates the maximum tremor intensity for each post. Recommendations have been made for earthquakeproof construction of various facilities. The possibility of preventing earthquakes was also discussed at the seismologists' meeting.

FTD/SNAP  
CSO: 1865/141

NEUTRINO RECORDING UNIT IN MINE 300 METERS DEEP

Kiev RABOCHAYA GAZETA in Russian 29 Apr 84 p 4

[Article by I. Adamov, engineer-designer of the "Metallist" plant (Artemovsk, Donetsk Oblast)]

[Text] Scientists of the USSR Academy of Sciences' Institute for Nuclear Research are working in a mine of the Artemovsk Salt Association in the Donets Basin. A neutrino unit has been assembled beneath a 300-meter layer of rock here. This unit is necessary for the registration of streams of elementary particles which originate in the Earth's atmosphere through the action of cosmic rays from the universe. The scientists proposed recording neutrinos in a mine for the purpose of separating them from the mass of other particles. Other particles do not pass through this thickness of earth.

An observatory with the world's first neutrino telescope has been built in a tunnel in the Baskaya Canyon in the North Caucasus. Both this observatory and the Artemovsk unit are part of the World Service for Tracing Flares of Supernova Stars.

The construction of a similar neutrino unit is planned also in a tunnel under Mount Monbban in Italy, with the assistance of Soviet scientists.

FTD/SNAP  
CSO: 1865/141

OPEN-PIT MINING EXCAVATORS DESIGNED FOR OPERATING AT LOW TEMPERATURES

Vilnius SOVETSKAYA LATVIYA in Russian 15 May 84 p 2

[Text] Visitors to the "Coal Industry" pavilion [of the USSR Exhibition of National Economic Achievements] will remember materials about the EKG-20, a caterpillar open-pit excavator with a bucket capacity of 20 cubic meters. It can operate at air temperatures as low as minus 50 degrees.

In this pavilion, data are also given on the hydraulic excavators EG-12A and EG-20, with bucket volumes of 12 and 20 cubic meters, respectively. These excavators can operate in a wide range of temperatures, from plus 40 to minus 40 degrees. Electric motors are installed in the excavators as their primary drive mechanism, in place of the diesel engines which were formerly installed in such machines.

FTD/SNAP  
CSO: 1865/159

DIODE-LASER GAS ANALYZER FOR GEOPHYSICAL STUDIES

Moscow MOSKOVSKAYA PRAVDA in Russian 28 Feb 84 p 3

[Text] Specialists of the USSR Academy of Sciences' Physics Institute imeni Lebedev and the Central Aerological Observatory have developed an original instrument which can be used in prospecting for oil and gas deposits, for predicting earthquakes, and for solving various geophysical problems. The instrument is a route-survey gas analyzer which is based on diode lasers. A number of recent developments of Moscow scientists and designers were used in the design of the new instrument.

FTD/SNAP  
CSO: 1865/136

## ESTONIAN GEOLOGIST COMPLAINS OF EQUIPMENT SHORTAGES, POOR COORDINATION

Tallinn SOVETSKAYA ESTONIYA in Russian 3 Apr 84 p 2

[Article by Ya.-M. Punning, director, laboratory of isotope geology, Geology Institute of the Estonian SSR Academy of Sciences, doctor of geographical sciences: "In Behalf of Accuracy of Evaluations and Conclusions"]

[Excerpt] The Geology Institute of the Estonian SSR Academy of Sciences has been given a number of tasks which it is experiencing delays in carrying out because of a shortage of modern series-produced apparatus. Most geological studies are based on specific facts, on data concerned with the composition of matter and its structure. Such studies cannot rely on data acquired in isolation, since the structure of our planet's geosphere and the particular features of its structure and development are the product of the total influence of many natural processes, and it is the latter that provide the statistics. Therefore dependable results may be obtained only on the basis of massed data. These truths may appear rather primitive, and it may seem that mentioning them in the periodical literature is not something necessary; unfortunately, however, it has become a daily practice to consider geological research institutions as second-class users of apparatus when such scientific apparatus is allocated to them. The apparatus they receive is inadequate even in its design concepts. Using such instruments, we are forced to constantly improve them, which in turn requires additional outlays of manpower, and this is especially difficult because as a rule, the geological research institutions do not have enough manpower.

The governing board and public organizations of the Geology Institute of the Estonian SSR Academy of Sciences have recently been devoting constant attention to developing the technical base. The institute is working in a number of research directions (isotope geology, electron microscopy) making use of highly modern equipment, owing to which the results of such research are enjoying nationwide recognition. Thus the isotope geology sector is said to be the country's best in relation to a number of problems presently being worked on here.

Because the Geology Institute is working on important scientific and practical tasks such as developing the scientific principles behind sensible and integrated use of natural resources, conducting regional hydrogeological studies and solving many problems concerned with environmental conservation, progress

in geochemical and geophysical research is falling behind. Inasmuch as the Geology Institute is the republic's sole institute conducting research in this area of science, it is natural for it to bear the responsibility for coordinating and conducting the republic's geological and geochemical specific-purpose programs. The institute believes its most important task to be integrated analysis of the reserves of shale and phosphorites in northwestern Estonia. Considering the uniqueness of these deposits, our geologists have a fabulous possibility for conducting theoretical research connected with formation of shale and phosphorites; this is not to mention the practical significance of such work.

The program of research on environmental conservation is also closely associated with this program. Considering widespread development and processing of natural resources, the time has come when the scale of man's activities is becoming comparable to that of natural processes. This unavoidably leads to change in the composition of the matter making up the superficial spheres of the earth, and primarily the hydrosphere and the upper layer of the earth's crust. Technological activities are resulting in the creation of new geochemical and ecological types of biospheres and new combined natural and technological landscapes. To protect nature from destruction of the natural balance within it, which could lead to irreversible processes, accurate expert assessments must be used when planning the national economy. Analyses of soil, water, plants and geological deposits alone are not enough for an assessment of changes in the environment. What we need first of all are integrated fundamental studies which would in turn require the appropriate qualifications in geology and geography. The primary task of geologists today is to study the natural laws governing the geochemical distribution of elements. Relying on the natural conditions of our specific territory and the nature of relationships between geochemical processes, we would be able to objectively evaluate the present state of the environment and forecast the direction of its development.

There are numerous facets to environmental research. This is why such research is conducted by different specialists and institutions. Such a broad approach is fundamentally necessary because it is only in this way that we can embrace the single whole. But unfortunately in the situation that is now evolving isolated collectives are studying isolated objects, using different procedures and making those conclusions that are specific to them. This approach carries a danger. First of all we still do not have an integral ecosystem conception or model applicable to territories within the republic subjected to the greatest load. Second, analytical data obtained in different institutions are often incomparable: Differences in methods and instrumental capabilities have an effect. Third, a situation may arise where an institution gathering analytical material is incapable of interpreting it from the standpoint of the natural sciences, and its assessments may consequently turn out to be false.

Considering the research subjects with which the Geology Institute of the Estonian SSR Academy of Sciences is involved, successful conduct of research on the problems named above would require creation of a modern integrated geochemical laboratory. It must be capable of investigating the composition and structure of matter at different levels, beginning with the microscopic level of individual minerals and ending with the composition of large aggregates.

This could be done, given the presence of a modern, fully automated measuring complex. Inasmuch as we are dealing with large masses of data, we need to think about their safe storage and mathematical treatment.

This task is a hard one to carry out. Besides the equipment, we also need the corresponding personnel and work space. But this is something which is necessary and which cannot tolerate any delays.

11004  
CSO: 1865/135

## NEW BOOK DISCUSSES NORMAL GEOMAGNETIC FIELD

Moscow NORMAL' NOYE MAGNITNOYE POLE ZEMLI in Russian 1984 (signed to press 5 Jan 84) pp 2-3, 232

[Annotation, foreword and table of contents from book "The Earth's Normal Magnetic Field" by Victor Ivanovich Pochtarev, Izdatel'stvo "Nauka", 650 copies, 232 pages]

[Text] This monograph contains a large quantity of factual material on the normal geomagnetic field and its gradients over the earth's surface at different elevations.

Methods are developed for plotting the normal geomagnetic field within the USSR and other states, and mathematical approximations of the geomagnetic field are presented. The nature of the earth's normal magnetic field is investigated on the basis of an analysis of geophysical, geological and geochemical data and data on the internal structure of the earth.

This book is intended for specialists in physics of the magnetosphere and geomagnetism.

### Foreword

The concept of the earth's normal magnetic field and the first planetary models of the earth's magnetic field or, using a shorter expression, the normal geomagnetic field, were introduced for the first time in the 19th century [1]. The need for considering a normal geomagnetic field came into being after intensive anomalies--that is, significant changes in the field within confined areas of the earth's surface elicited by various geological and physical causes, and primarily by the presence of highly magnetic iron ores in the earth's crust--were discovered in the structure of the earth's magnetic field in different regions of the globe as a result of magnetic surveys. The anomalies were like islands on the surface of the earth's smoothly varying magnetic field, brought about by planetary causes having their origin inside the earth, and naturally occurring over the earth.

Since that time the normal field has enjoyed wide use in the practical work of geophysicists involved in geological and physical interpretation of magnetic

anomalies and in magnetic cartography on one hand and in the general properties of the earth's magnetic field and its nature on the other. It is impossible to compile summary charts of anomalous fields covering significant territories and generalizing the results of magnetic surveys made in different years without using a single, properly selected elevation. This elevation must be such that the magnetic anomalies that are distinguished do exhibit a real physical and geological nature.

Models of the normal magnetic field and the methods of their acquisition and representation continually improved, and now there are sufficiently well developed theoretical principles and mathematical methods of building and representing various models of the normal geomagnetic field, both within the confines of particular states and regions and on a planetary scale.

As a certain level of reckoning which includes the principal or main portion of a field or another phenomenon, the normal field is used in areas other than geomagnetism. The theory and practice of gravimetry would be unimaginable without models of the normal field of earth gravity--a spheroid, an ellipsoid or a geoid.

The concepts "normal field," "normal elevation," "normal background," and "norm" are used in many sciences.

Therefore subdivision of the complex phenomenon into normal--main or primary, brought into being by basic (general) causes--and anomalous--secondary, existing as a consequence--serves a purpose in terms of general scientific methodology.

However, no works generalizing information on the normal geomagnetic field have appeared in the geophysical or other scientific literature in the last 30 years. This compelled us to write a book on the normal geomagnetic field based on many years of study conducted under the author's guidance in the Leningrad department of the USSR Institute of Terrestrial Magnetism, the Ionosphere and Radio Wave Propagation. It explains the history of the problem, it examines various methods of building models of the normal geomagnetic field within the USSR and over the globe and various methods of representing them, and it briefly describes the residual or anomalous fields that have been obtained. The book provides a considerable quantity of factual material on the normal geomagnetic field on the earth's surface and at different elevations, including in near-earth space. This information may be used in research on the various processes and phenomena occurring within the earth's magnetosphere and experiencing the influence of the earth's magnetic field.

The following colleagues of the Leningrad department of the Institute of Terrestrial Magnetism, the Ionosphere and Radio Wave Propagation took part at different times in research on the normal geomagnetic field conducted under the author's guidance: B. D. Vints, candidates of physicomathematical sciences V. I. Kolesova, M. A. Efendiyeva, A. A. Petrova, D. P. Golub, A. I. Grishina, N. I. Petrova, A. A. Vasil'yeva and I. G. Simakov. The author expresses his sincere gratefulness to all of them.

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BOOK: COLLECTION OF ARTICLES ON GEOPHYSICAL METHODS OF OIL AND GAS EXPLORATION

Perm GEOFIZICHESKIYE METODY POISKOV I RAZVEDKI MESTOROZHDENIY NEFTI I GAZA in Russian 1981 (signed to press 25 Dec 81) pp 2, 144-145

[Annotation and Table of Contents from Book, "Geophysical Methods of Oil and Gas Deposit Exploration and Prospecting", A. K. Malovichko, chief editor, Perm University, 146 pp

[Text] Annotation.

The collection features articles on the topics of processing and interpretation of the results of geophysical observations on exploratory prospecting jobs in oil and gas. Problems examined include gravitation prospecting (isolating anomalies from the upper mantle, isolating "oil pool" type anomalies, calculating the inequality of temporary shoulders when processing observations, and others), seismic survey (the range of waves in a stratified medium, the use of the first arrival for calculating statistical corrections, determining velocities by observations of non-longitudinal profiles, the construction of sections under the conditions of an anisotropic medium, and others), electrical logging (the influence of anisotropy on apparent resistivity curves, use of computers for automating vertical electric sounding interpretation), magnetic prospecting (determining coffer fold parameters, the association of reefs and ring structures, distribution of the magnetic properties of sedimentary rock).

The articles in the collection are of interest to geophysicists conducting research on oil and gas, and to students. Thematically the collection is a continuation of the series of collections "Questions in Processing and Interpreting Geophysical Observations" (No 1-14) and "Geophysical Methods of Oil and Gas Prospecting and Exploration" (1979, 1980), and should be considered number 3 (17).

It is printed by decree of the Perm University editorial-publishing council.

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12461

CSO: 1865/129

REGIONAL CENTER FOR SCIENTIFIC DATA IN DUSHANBE

Moscow PRAVDA in Russian 24 Feb 84 p 6

[Article by O. Latifi in the column "Along with Scientist": "Earthquakes into Collection"]

[Text] Before leaving the house, we inquire about what kind of weather is being expected today. All of us, and especially agriculture and transport workers, are interested in weather forecasts. The time will come when it will be possible to announce: on such-and-such day, at such-and-such time, an earthquake of such-and-such intensity will occur. Information on underground trembling, stored in a seismic data bank, will help to predict an impending earthquake. Such an institution, the first in the country, is now being established in Dushanbe.

K. Mirzoyev, the deputy director of the Institute of Seismic-Resistant Construction, familiarizes us with laboratories of scientific research automation and numerical techniques. These laboratories deliver the information into the seismic data bank.

The seismologist "household" looks like an ordinary computer center. An antenna set on the roof of the Institute captures signals coming from stations located within a 35-40 kilometer radius. This area is the Dushanbe-Vakhsh test area--the prototype system under refinement.

The signals, even after they pass through scientific instruments and computers, merely mark the place and the intensity of the detected earthquake. Up to three thousand underground shocks a year are being registered in the region of Tajik capital, but usually only a few of these are perceptible.

Suppose, for example, that the signals which have arrived from Nurek Hydroelectric Power Plant differ from the usual ones. A decision is made to compare these with many years data from this region. Scientists pick up a disc stored on a shelf and insert it into a kind of a record player. Instantly, the "behavior" of depths of the earth in the past is being presented. Data stored in the computer memory contain information on nearly one hundred thousand earthquakes recorded in the Tajik SSR.

The most ancient one is dated back to 1490. Facts about earthquakes which have occurred in the past centuries are gathered from historical manuscripts, chronicles and scientific publications. The regional center at Dushanbe is

already functioning, not waiting for the appearance of an automated data reception system. Seismologists from sister republics transmit their data by telephone or send them by mail. In the Institute they study and correlate the incoming data. There are seismic bulletins published weekly and monthly.

The publisher for the Tajik Academy of Sciences has started a regular collection of PROGNOZ ZEMLETRYASENIYA [Earthquake Forecast]. Articles depict a very multisided phenomenon. Nevertheless, we are getting closer to the target. Already, several predictions have proved themselves.

"However the subject is not without finesse," says S. Negmatullayev. "Weather reports are another matter. Suppose they predicted a dry day but it started to rain and you did not take along your umbrella--just bad luck. Seismic forecasts, however, can be the source of anxiety. The main thing, therefore, when choosing a place for laying of a foundation and determining the construction durability is to follow the seismological recommendations."

The 300-meter dam of the Nurek Hydroelectric Power Plant has been built according to calculations of scientists from the Institute. I was witnessing the dam testing. Underground shocks of maximum intensity were generated using explosives. The construction sustained.

"A day will come", concludes K. Mirzoyev, "when we will have the ability to transform the strong shocks into a series of barely noticeable ones, causing, if anything, a short jingle of a chandelier."

12603  
CSO: 1865/72

UDC 550.834

## PROBLEMS IN SEISMIC ANISOTROPY OF THIN-LAYERED MEDIA

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 4: GEOLOGIYA in Russian  
No 5, Sep-Oct 83 (manuscript received 17 Jan 83) pp 68-75

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[Abstract] Thin-layered media (TLM) constitute one of the principal types of geological media characterized by seismic anisotropy. These media have an important role in the structure of the sedimentary basins forming strata containing petroleum, gas and coal. Some sectors of the consolidated crust also have a thin-layer structure. The seismic anisotropy of TLM has been studied at Moscow State University since 1968. This article examines the following aspects of the problem: correlation between the seismic anisotropy of TLM and the nature of velocity differentiation of the medium, conditions for appearance of loops on the wave surfaces of SV waves and peculiarities of TLM in comparison with other types of transversally isotropic media. The author first examines a two-component TLM and it is shown that its local characteristics are determined by the parameters of layers I and II (velocities  $v_{P1}$ ,  $v_{P2}$ ,  $v_{S1}$ ,  $v_{S2}$ , densities  $\rho_1$ ,  $\rho_2$ , thicknesses  $h_1$ ,  $h_2$  and their ratios, and very importantly, the parameters  $n_{P1}$  and  $n_{S1}$  characterizing velocity differentiation of the medium. It is shown that there are three types of change in the velocities of quasilongitudinal P-waves for two-component TLM. Then the article examines how elastic anisotropy is related to the differentiation of the velocities of P and S waves for a three- (or more) component TLM. It can be represented as the sum of two two-component models. Each of them can be characterized by one of the three types considered for the two-layer model. The following combinations are possible: I-I, II-II, III-III, II-III. Proceeding on this basis it was possible to establish the correlation between the nature of differentiation on the basis of the velocities  $v_P$  and  $v_S$  of multicomponent thin-layered periodic and aperiodic sections and the ratio of integral elastic properties. The conditions for presence of loops on the ray velocity curves for the SV waves were obtained for a thin-layer periodic medium. Finally, the peculiarities of elastic anisotropy of thin-layer media were determined in comparison with other types of transversally isotropic media. Figures 4, tables 1; references 20: 12 Russian, 8 Western.

[87-5303]

## SPECTRAL APPROACH TO INTERPRETATION OF ELECTROMAGNETIC ANOMALIES IN CASE OF E-POLARIZATION

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 4: GEOLOGIYA in Russian No 5, Sep-Oct 83 (manuscript received 10 Aug 82) pp 95-98

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[Abstract] The article describes the theory of a spectral approach to the interpretation of deep anomalies of the earth's electromagnetic field. The model used is described as follows: a plane horizontal surface  $\Gamma$  separates the nonconducting atmosphere ( $\sigma_0 = 0$ ) from an earth with the constant conductivity  $\sigma_n$ . The earth has an inhomogeneity with the section D and the conductivity  $\sigma_n + \Delta\sigma(x, z)$ . The medium is homogeneous in the y direction. The model is excited by a plane wave with the components  $\{E_y, H_x\}$ . The  $\vec{E}$ ,  $\vec{H}$  fields and conductivity  $\sigma_n$  at the  $\Gamma$  surface are known. The first stage in the interpretation involves discrimination of the main part of the anomaly; the method for solving this problem was given by M. N. Berdichevskiy, et al. in the monograph INTERPRETATSIYA ANOMALIY PEREMENNOGO ELEKTROMAGNITNOGO POLYA ZEMLI, Moscow, 1981. The article shows that the following stages are involved in interpreting electromagnetic anomalies of the defined type: 1) discrimination of main part of the anomalous field  $\vec{E}^A$  and  $\vec{H}^A$ ; 2) finding the total anomalous field  $\vec{I}$ ; 3) finding horizontal coordinate of center of anomalous currents; 4) finding vertical coordinate of center of anomalous currents; 5) determination of other parameters of inhomogeneity:  $S = I_y^2 / E_y^2$  and  $\Delta\bar{\sigma} = S/D$ , where S is the total longitudinal conductivity of the inhomogeneity,  $E_y$  is the mean field at the depth  $z_c$ ,  $\Delta\bar{\sigma}$  is the excess mean conductivity of the inhomogeneity. This spectral interpretation approach gives considerable information on the inhomogeneity in a conducting half-space without any assumptions concerning its form. Figures 1; references: 1 Russian.  
[87-5303]

## SEISMIC NOISE IN NEIGHBORHOOD OF NOVOSIBIRSK

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 1, Jan 84  
(manuscript received 1 Feb 83) pp 77-84

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[Abstract] The article discusses the level, spectral composition, nature and frequency of appearance of all types of seismic oscillations in the neighborhood of Novosibirsk. All types of seismic disturbances are dependent on the

observation site (geological structure, remoteness from transportation facilities, factories and seismically active zones) and therefore all pertinent sources of seismic noise were measured and analyzed. The data were collected within Novosibirsk itself and at a distance of 20 miles from the city. The morphology and geology were essentially the same at both places. The distance of the region from active epicentral zones is between 500 and 5,000 km. Details are given on measurement and analysis of these parameters. Each of the types of seismic noise (industrial, transportation, microseisms, etc.) is discussed in detail. It was found that the greatest amplitude of the soil tremors is from earthquakes, explosions and industrial machinery. The first two sources are sporadic and the third is virtually continuous. The main factors determining the parameters of industrial noise are the directivity of the seismic radiation of machinery consuming large amounts of energy and the geological and geophysical parameters of the medium. The influence of transportation and industrial seismic noise can be reduced by using the filtering properties of the medium. The constant seismic background at a distance of 10-20 km from large cities is of a technogenic character. Figures 4; tables 3; references 16: 15 Russian, 1 Western.

[99-5303]

UDC 550.837.2

#### SEPARATING NORMAL AND ANOMALOUS FIELDS USING MEASUREMENTS IN LIMITED AREA

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 1, Jan 84 (manuscript received 15 Nov 82) pp 100-104

AKSENOV, V. V., Systems Scientific Research Institute, Novosibirsk

[Abstract] Areal measurements have made it possible to formulate an interpretation theory and to write algorithms for the analytical description and separation of fields into fields of magnetic and electric types and into external and internal fields. These algorithms can be supplemented by algorithms for the separation of the internal field of magnetic and electric types into normal and anomalous parts. The literature does contain methods for the separation of normal and anomalous fields on the basis of areal methods, but in general their use is extremely difficult. The author therefore has proposed a new separation method based on the use of the analytical dependence of the coefficients of spatial analysis of the field on the density of currents at the sources. This requires that the electromagnetic variations in a local sector of the field be subjected to spatial analysis and field separation using the formulas given by the author in his monograph INTERPRETATSIYA ELEKTROMAGNITNYKH VARIATSIY (interpretation of Electromagnetic Variations) (Moscow, Nauka, 1982). The electric field can be used in computing the coefficients of the normal field on the assumption that the mechanism of excitation of currents in the earth is purely inductive. The anomalous field is determined by subtracting the normal field from the internal field. The next step is separation of the anomalous field into the field of deep and surface anomalies. For discriminating surface anomalies additional information is required on surface conductivity  $\sigma_{surf}(r, \varphi, z)$ . If it is considerable and

its distribution law is known, it makes sense to compute the field of surface anomalies. This necessitates computing the coefficients of the field of surface anomalies using the analytical dependence from the monograph, information on  $\sigma_{\text{surf}}(r, \varphi, z)$  and the electric field of external sources. The coefficients for the magnetic and electric fields of the surface anomalies are substituted into earlier derived formulas in place of the coefficients of the internal field and thus the field of surface anomalies is computed. This field must then be subtracted from the anomalous field. This gives the field of deep anomalies of the magnetic and electric types. The field of deep and surface anomalies can be subjected to geological and geophysical interpretation for detecting geological objects of interest. References: 3 Russian.  
[99-5303]

UDC 550.83:552.587(571.56)

#### MULTISIDED GEOPHYSICAL INVESTIGATIONS OF PETROLEUM AND GAS REGIONS IN YAKUTIA

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 12, Dec 83  
(manuscript received 14 Jan 83) pp 120-124

VYALKOV, V. N., GREBENKIN, T. Ya. and MATVEYEV, V. D., Yakutsk Geophysical Trust

[Abstract] An important role in studying the geological structure of regions in Western Yakutia which are promising for the discovery of petroleum and gas is played by geophysical methods, including aeromagnetic, gravimetric, electrometric and seismic surveys. A general aeromagnetic survey has covered virtually the entire territory of Western Yakutia, gravimetric surveys have covered most of the petroleum and gas regions, 70% of the area has been covered by magnetotelluric soundings and more than 114,000 km of seismic profiles have been run with different variants of seismic prospecting. Nevertheless, the entire area must be regarded as poorly studied by geophysical methods. The authors here give a review of the results of the petroleum and gas prospecting work which has been carried out up to the present time, together with an evaluation of the effectiveness of individual field methods. The difficulties caused by the remoteness of the region and its complex structure are discussed. Particular emphasis is given to seismic prospecting and the advances in techniques which have been introduced in recent years. The principal geological and geophysical factors exerting an influence on the preparation of complexly structured formations are outlined. It is stressed that one of the most promising directions in increasing geophysical work is the introduction of methods for predicting the geological section and detecting anomalies of geophysical fields caused by petroleum and gas deposits. There is a need for upgrading the instrument and apparatus used in the work; computers must be introduced in much greater numbers. Most importantly, it is essential to combine use of geophysical methods where it appears advantageous to do so.  
[77-5303]

UDC 550.834.42(571-925.16)

DETAILED STUDY OF EARTH'S CRUST IN BAYKAL RIFT ZONE ACCORDING TO REFRACTED WAVES DATA

Nososibirsk GEOLOGIYA I GEOFIZIKA in Russian No 12, Dec 83  
(manuscript received 14 Mar 83) pp 82-91

MISHEN'KIN, B. P., MISHEN'KINA, Z. R. and SHELUD'KO, I. F., Institute of Geology and Geophysics, Siberian Department, USSR Academy of Sciences

[Abstract] Investigations of the crust and upper mantle by the deep seismic sounding method have been carried out in the Baykal rift zone and adjacent territories since 1968. This has made it possible to determine the principal features of deep structure of the region and the anomalous peculiarities of deep structure distinguishing the rift zone from neighboring inactive regions. One of the characteristics of rift zone crustal structure is an inversion of velocity of longitudinal waves (waveguide layer). The decrease in velocity relative to the surrounding rocks by 0.2-0.3 km/sec occurs in the depth range 12-17 km; the waveguide may be discontinuous. It can be postulated that this layer of reduced velocity is the seismically controlling object in the tectonically active Baykal rift zone. The study of the intracrustal seismic waveguide is of fundamental importance in predicting earthquakes. A further investigation of the waveguide layer and the change in its parameters required development of new procedures for interpreting refracted waves, which are the best for this purpose. Accordingly, the authors have prepared an algorithm for the interpretation of refracted waves for two-dimensional media containing such a waveguide. The  $v(x, z)$  function is determined from profile observation systems with use of the  $t(x, \ell)$  time field of refracted waves. The use of the algorithm is illustrated in theoretical models. The described algorithm was used in interpreting the first arrivals in detailed field work in the north-eastern sector of the zone. The results given here show that the velocity section is characterized by substantial velocity changes in the upper and middle parts of the crust in both vertical and horizontal directions.

Figures 5; references: 6 Russian.  
[77-5303]

UDC 550.05:550.834:551.243

FAULTS AND NATURE OF SEISMIC DISCONTINUITIES IN CONTINENTAL CRUST SECTION

Moscow SOVERSAYA GEOLOGIYA in Russian No 1, Jan 84 pp 112-120

SHAROV, V. I., USSR Ministry of Geology

[Abstract] Studies of tectonic destruction of rocks, with lithostatic pressure taken into account, has revealed several stages or geotectonic levels of crustal stratification differing in the geometric parameters of fissuring and permeability, and therefore the conditions for the transfer and transformation

of matter. The geotectonic levels control the development of faults and therefore are of the greatest importance for clarifying the kinematic and dynamic conditions for crustal movements. Analyses of seismic wave reflections from faults on the Ukrainian shield have revealed a vertical zonality in change of their dips which is consistent with rheological stratification of the crust. The dilatancy mechanism of fracture formation, leading to a regular change in the form of manifestation of faults at different depths in the crust, makes it possible to explain many phenomena related to rock destruction. A nontraditional interpretation of the nature of seismic discontinuities, taking into account the dilatancy mechanism of rock destruction, has allowed a reappraisal of the depth of penetration of faults into the crust and mantle. Rock destruction and fault formation also occur below the Moho. In the upper mantle, as in the crust, the distribution of seismic activity is controlled by the seismic stratification of the section, determined by a regular alternation of brittle and pseudoplastic rock destruction. Each active (brittle) stage is between waveguides which prevent the simultaneous through development of localized faults in all stages of the destruction region. Crustal faults are limited downward by the level of pseudoplastic flow situated between the Conrad and Mohorovicic discontinuities, with no upward boundary. Crustal seismic discontinuities are not governed by a change in the composition of crystalline rocks but by rheological stratification, the basis for which is the dilatancy mechanism of rock destruction. Subhorizontal seismic discontinuities are geotectonic levels of crustal stratification controlling the development of faults, fissuring, permeability and the intensity of crustal transfer of matter. The vertical zonality of rock destruction, reflected in seismic stratification of the crust and upper mantle, is evidently the most important feature of many geological processes and phenomena. Figures 4; references: 15 Russian.  
[79-5303]

UDC 550.347.62(470.67)

#### DOWNWARPING AND EARTHQUAKES INDUCED BY FILLING OF LARGE RESERVOIRS

Moscow SOVETSKAYA GEOLOGIYA in Russian No 1, Jan 84 pp 120-125

SAIDOV, O. A., Institute of Geothermal Problems, Dagestan Affiliate, USSR Academy of Sciences

[Abstract] An increase in local seismicity accompanying the filling of large reservoirs can cause tremors adequate for the damage of hydraulic and other structures. Earthquakes in the neighborhood of large reservoirs occur with a combination of the following conditions: presence of tectonic inhomogeneities in the rock complex; good permeability of rocks and fractures at great depths and presence of a hydraulic coupling of reservoir water with pore water; reservoir water over 100 m deep. It is also essential that there be critical stresses in the rocks close to the strength parameters of the medium. The author gives a numerical evaluation of downwarping of rocks making up the neighborhood of the Chirkeyskoye Reservoir and describes the role of this process in the formation of earthquake foci. It was found that under the

influence of a water load the crust under the reservoir bed is elastically deformed, as a result of which the most favorable geological and hydrogeological conditions appear for the formation of earthquake foci at the margins of the downwarping zone, especially in the initial stage of filling. This is confirmed by the fact that most earthquake foci are associated with the marginal sectors of the downwarping zone. Oscillatory motions of the crust caused by the cyclic effect of a water load during reservoir operation cause a periodic burst of seismic activity both at the downwarping periphery and under the reservoir due to the formation of dilatation zones in the crust. The change in the mechanical properties of the medium, especially a decrease in its strength as a result of filling and operation of the reservoir, leads to a premature destruction of rocks and the forming of small-focus earthquakes. Figures 4; references 10: 9 Russian, 1 Western.  
[79-5303]

UDC 550.348.098.64

#### SEISMIC RISK EVALUATION FOR KAMCHATKA REGION USING CRITERIA FORMULATED FOR ANDES MOUNTAIN ZONE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 1, Jan 84  
(manuscript received 14 Apr 82) pp 20-33

GVISHIANI, A. D., ZHIDKOV, M. P. and SOLOV'YEV, A. A., Institute of Physics of Earth imeni O. Yu. Shmidt, USSR Academy of Sciences

[Abstract] In an earlier study ("Identification of Sites of Possible Occurrence of Strong Earthquakes. X. Sites of Earthquakes With  $M > 7.75$  on Pacific Ocean Coast of South America," VYCHISLITEL'NAYA SEYSMOLOGIYA, No 14, pp 56-67, 1982), the authors obtained high seismicity criteria for South America which they feel may be applicable to similar regions. Accordingly, the methodology and conclusions presented in that study are applied here in an effort to define the sites of occurrence of earthquakes of the same energy level on Kamchatka. It was found that 2/3 of the sites pinpointed in Eastern Kamchatka can be assigned to the earlier defined class "B" (objects near which the epicenters of strong earthquakes are possible). The considered cases included all objects near which there were epicenters of earthquakes with  $M \geq 7^{3/4}$  occurring during the period 1900-1980. The validation of the procedure is presented at length. This is followed by a detailed description of the morphostructure and seismicity of Kamchatka in comparison with the Andes zone; Fig. 1 is a map of morphostructural regionalization of Kamchatka. The classification as applied to Kamchatka shows that most of the class "B" objects correspond to intersections of the abyssal trench, agreeing with the concept of high seismicity of an abyssal trench and a decrease in the seismicity level with increasing distance from the trench. Figures 1, tables 6; references: 44 Russian.  
[85-5303]

## STRONG EARTHQUAKE SPATIAL-TEMPORAL CORRELATIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 1, Jan 84  
(manuscript received 9 Jun 82) pp 34-38

ZHADIN, V. V., Mining Institute, Siberian Department, USSR Academy of Sciences

[Abstract] In the search for spatial-temporal correlations of strong earthquakes the author has used an approach developed by Sh. A. Guberman in DOKL. AN SSSR, Vol 230, No 6, p 1314, 1976. This involves plotting of migration schemes based on some hypothetical global wave processes, the interaction of whose fronts with one another or with geological structures leads to the appearance of earthquakes. It is assumed that the energy carried with the magnetic convection flux is scattered in the form of some slowly moving waves whose formation is related to the phase transformations of matter. In constructing the migration schemes a simplified method is used which is based on a search for the correlation between earthquakes with  $M \geq 7$ , considered as indicators of the movement of energy fluxes. A migration cycle is represented as a process of propagation of the epicenters of earthquakes along the earth's surface in all directions with a constant velocity from some source represented by a point (cycle epicenter). Each individual cycle is characterized by the coordinates of its epicenter, source time  $T_0$ , energy and minimum and maximum radii of manifestation of seismic activity. The appearance of each earthquake entering into a given cycle is identified with the intersection of its epicenter by the seismic activity migration front. The energy of the migration cycle is the total energy of the earthquakes making it up. During the period 1963-1976 about 80% of the earth's seismic activity was attributable to earthquakes grouped in four migration cycles. These cycles of increased energy included earthquakes with  $M \geq 8$ , a relatively large number of earthquakes with  $M \geq 7$ , forming powerful bursts of seismic activity, and earthquakes with  $M \geq 7$  occurring outside zones of increased seismic activity. The highest seismic energy, about 50% of the energy of all the earthquakes during 1963-1976, is accounted for by the migration cycle with the source epicentral coordinates  $19^{\circ}\text{N}$ ,  $170^{\circ}\text{E}$  and  $T_0$  --February 1945. The migration cycles were constructed using data on 217 earthquakes with  $M \geq 7$  during this period; a map in the text shows the location of the epicenters of the sources of migration cycles. As proof of the reality of existence of some mechanism of wave transfer of energy along the earth's surface, reflected in the proposed scheme of radial migration of seismic activity, the author cites: confirmation of the constancy (within the limits of 5% error) of the velocity of movement of migration fronts and the spatial distribution of the epicenters of sources of the migration cycles, which can be explained on the basis of the mantle convection hypothesis. Figures 3, tables 2; references 6: 4 Russian, 2 Western. [85-5303]

VERTICAL MOVEMENTS AND MAGNETIC VARIATIONS BEFORE EARTHQUAKES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 1, Jan 84  
(manuscript received 25 May 82) pp 49-53

GUSEVA, T. V., DOBROVOL'SKIY, I. P., PERSESOV, I. L. and SKOVORODKIN, Yu. P.,  
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[Abstract] Observations in the Garm polygon in the Tajik SSR over the course of many years have revealed anomalous vertical movements of the earth's surface and geomagnetic field variations associated with preparation of a number of local earthquakes. The most detailed geodetic measurements were made during 1972-1978 (average of 10 cycles annually). Analysis of time series of vertical movements  $H$  for a period of more than 20 years made it possible to define the trend of relative vertical movements with an accuracy to 0.1 mm/year. The trend component is quite different for points situated in different structural elements. Against the background of  $H$  changes there are disturbances  $\Delta H$ , the difference between the current  $H$  values and those computed on the basis of linear drift; these disturbances exceed the measurement errors and exhibit a spatial-temporal correlation with earthquakes. The  $\Delta H$  value changes with time and attains a maximum value directly before an earthquake. The duration of the  $\Delta H$  disturbances reflects the earthquake preparation time and for the analyzed events was 3-9 months. Computations were made using a phenomenological model in which the earthquake preparation process is represented in the formation of genesis and development of some inhomogeneity in the earth's crust. The magnetic variations were computed on the basis of the piezomagnetic effect with use of the mechanical stress values given in the preparation model. The satisfactory agreement of computed values and field observations indicates that the quantitative model presented here correctly describes the "consolidation" phase in earthquake preparation, at least within the limits of a zone not exceeding the mean focal radius by a factor of more than 7-10. Figures 2; tables 1; references 9: 7 Russian, 2 Western.

[85-5303]

SEISMIC SLIPPAGE ALONG DARVAZ-KARAKUL FAULT

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 1, Jan 84  
(manuscript received 14 Sep 80) pp 39-48

KUCHAY, O. A. and YUNGA, S. L., Institute of Seismic-Resistant Construction and Seismology, Tajik Academy of Sciences; Institute of Physics of Earth imeni O. Yu. Shmidt, USSR Academy of Sciences

[Abstract] The authors computed seismic slippage along the Darvaz-Karakul fault and obtained qualitative evaluations of the direction of the Pamir-Badakhshan block. Movement along the fault is considered as the relative movement of the blocks adjacent to the fault. This movement can occur both together

with seismic phenomena and by means of slow aseismic slippage. The Darvaz-Karakul deep marginal fault is among the principal dislocations in the territory of Tajikistan-Afghanistan. The fault zone consists of a chain of conjugate dislocations. The width of this seismogenic zone is 25-30 km. The northern subzone of the fault is more active, with frequent occurrence of earthquakes with  $M \approx 6$ , whereas in the southern subzone the maximum magnitude of known earthquakes is limited to 5.5. The parameters of the focal mechanisms of earthquakes occurring near the fault were determined on the basis of the signs of the first arrivals in longitudinal waves. A map accompanying the text shows the distribution of the focal mechanisms of earthquake foci in the fault zone. Data on 64 earthquake mechanisms are presented and the type of movement and the rate of slippage in different segments of the fault were ascertained. The rates of seismic slippage are estimated at approximately  $10^{-2}$ - $10^{-1}$  cm/year. The results of this investigation do not contradict existing concepts concerning movement of the Pamir-Badakhshan block in a northerly-northwesterly direction. Figures 3, tables 1; references 26: 25 Russian, 1 Western.  
[85-5303]

UDC 550.837.6

#### NEW TYPES OF TRANSIENT PROCESSES OBSERVED IN ELECTROMAGNETIC SOUNDINGS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 1, Jan 84  
(manuscript received 15 Feb 83) pp 100-103

MOLCHANOV, A. A., SIDOROV, V. A., NIKOLAYEV, Yu. V. and YAKHIN, A. M.,  
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[Abstract] Practical work by several variants of the electromagnetic sounding method has revealed the presence of anomalous transient processes which have been assigned the designation type-a anomalies. Using a modern measurement system there is a change in the sign on  $\xi(t)$  and after a minimum a monotonic approach to zero. According to classical theory such  $\xi(t)$  curves are impossible. They can be explained only with additional allowance for polarizability of the medium. The increase in measurement accuracy, with registry of processes in the microsecond range, has led to the discovery of still other anomalous processes: type b, with a change in sign, but after a minimum the signal again becomes positive: type c, without a change in the sign on the signal, but in some interval there is a positive sign on the first derivative and in a positive transient process there is a distinct minimum, then a maximum and a subsequent dropoff of the signal; type d, with simple qualitative differences from a normal process absent, but the process not corresponding to the theoretical process, calculated only with allowance for active conductivity of the medium. Processes of these types are registered over sedimentary rocks with resistivity of the layers from tens to several thousand ohm·m. It appears that all the new types of curves can be attributed to the inductive influence of vertical polarization. This may complicate interpretation of the transient processes, but can play a positive role in geophysics. Anomalous transient processes, for example, have been observed near kimberlite pipes and can serve as an indicator of diamond deposits. Figures 2; references 14: 12 Russian, 2 Western.

[85-5303]

QUASI-THREE-DIMENSIONAL MODELING OF MAGNETOTELLURIC FIELDS IN SOUTHERN TURAN  
PLATFORM AND SOUTH CASPIAN MEGADEPRESSION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 1, Jan 84  
(manuscript received 16 Nov 82) pp 69-81

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University

[Abstract] Anomalies of the magnetotelluric field have been detected in many regions of the earth. In some cases these are attributable to the presence of intermediate conducting layers in the crust and upper mantle at depths from 10-20 to 100-200 km. In such cases for success in interpreting the results of deep magnetotelluric soundings it is necessary to develop methods for computing electromagnetic fields in three-dimensionally inhomogeneous media. This article gives the results of numerical modeling of fields for a region including the southern part of the Turan Platform and the South Caspian Megadepression. Work has been carried out in this region for some years with collection of considerable data on the edge, induction, S and current channelization effects, virtually all the known forms of distortions. A quasi-three-dimensional model was used in which the lateral inhomogeneities fall in the thin inhomogeneous surface layer and the deep part of the section is represented by a conductor having conductivity dependent only on depth. The authors stress the importance of the distorting influence of surface inhomogeneities as one of the explanations for the magnetotelluric field anomalies detected in this region. Leakage currents through the conducting base of the sedimentary layer or faults play a substantial role in forming the regional characteristics of magnetotelluric fields. It is clear that such distortions occur widely and computations are needed for clarifying their role for all regions where magnetotelluric field anomalies have been discovered. Figures 7; references 20: 12 Russian, 8 Western.

[85-5303]

UDC 550.812

LITHODYNAMIC RESEARCH METHOD FOR IMPLEMENTING GEOLOGICAL PROSPECTING WORK  
IN COASTAL MARINE PLACERS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in  
Russian No 1, Jan 84 pp 74-77

CHUBSHEV, A. Ye. and TURKIN, N. Ye., Primorskgeologiya Geological Production  
Association

[Abstract] The article outlines a method for geological prospecting in marine coastal placers in the closed seas of the USSR on the basis of lithodynamic research during the period 1976-1981. This work was directed to determination of the dynamics of changes in sediments in marked-off sectors. The following problems have been solved: determination of the presence and thickness of the

active layer, changes in its morphology within a marked area and in adjacent areas; determination of the mineral content in the active layer; determination of the velocities and directions of movement of sediments; obtaining the hydrodynamic and meteorological characteristics of such sectors; compilation of lithodynamic charts and graphs showing changes in individual parameters of movement of sedimentary material; discrimination of sectors with different degrees of enrichment, depletion, replenishment, dynamic equilibrium; calculation of dynamic reserves; prediction of dynamics of change in active layer. Presence of the active layer is established by both indirect criteria and by tagging the sediments. Data must be collected on the granulometric composition of the sedimentary material and such morphological structures of bottom relief as slope of layers, uplifted and subsided sectors and presence of ripples. Underwater navigation and communication instruments and apparatus are used and divers and underwater photography play important roles. Specific information is given on individual procedures, such as for determination of active layer thickness and changes in its morphology, for determining the direction and rate of sediment movement and for determining hydrodynamic characteristics. Not only does the method make possible calculation of the dynamic reserves of the useful component, but also a relatively reliable prediction of changes in active layer sediments. Among the inadequacies of the method are the following: much preliminary diving work by skilled specialists and inability to make observations during a storm. However, the advantages of the method outweigh any possible disadvantages. Figures 3; references: 3 Russian.  
[97-5303]

UDC 551.482

GENETIC TYPES OF GEOLOGICAL BODIES OF SEDIMENTARY MANTLE (BASED ON SEISMIC PROFILING DATA)

Moscow BYULLESEN' MOSKOVSKOGO OBRASHCHESTVA ISPYTATELEY PRIRODY: OTDEL GEOLOGICHESKIY in Russian Vol 59, No 1, Jan-Feb 84 pp 28-36

SHIMKUS, K. M. and SHLEZINGER, A. Ye., Southern Division, Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Gelendzhik; Geology Institute, USSR Academy of Sciences, Moscow

[Abstract] The structure of geological bodies of the epicontinental basins has been determined rather well, but it has been found that there are some peculiarities of structure of the sedimentary mantle not characteristic of epicontinental basins of the geological past. Adequate data are now available for classifying all such formations. The authors have developed such a classification based on seismic data on the Paleozoic, Mesozoic and Cenozoic deposits of the East European Platform, Turan, Scythian and West Siberian Platforms, internal seas of the Mediterranean and Caribbean zones, marginal seas of the northwestern Pacific Ocean and various sectors of the Atlantic, Indian and Pacific Oceans. An analysis of these data made possible a reliable determination of the genesis of geological bodies, a clarification of the related tectonic circumstances and peculiarities of sedimentation. The genetic classification of geological bodies of the sedimentary mantle presented here is validated and illustrated by specific material. As reflected in the

classification, all such formations can be classified into two groups: 1) differentiated downwarping (epicontinental basins) and 2) sedimentation traps (abyssal basins). These are divided into a number of classes, subclasses and types, each of which is discussed. Figures 3; references 28: 21 Russian, 7 Western.

[78-5303]

UDC 528.063.1:528.23

#### APPLICATION OF RECURRENT FORMULAS FOR SOLVING MAIN GEODETIC PROBLEMS

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 1, Jan 84 pp 17-20

GAN'SHIN, V. N. and LAZAREV, V. M.

[Abstract] In the usual approach to solution of main geodetic problems in a rectangular coordinate system in a Gauss projection the expansion coefficients are obtained by successive differentiation. In this article the authors propose recurrent formulas which make it possible to obtain a solution with any number of expansion terms. The application of these formulas with a YeS 1022 computer with a 256 K memory made it possible to solve direct main geodetic problems for zones with a width up to  $120^\circ$  and inverse problems for zones with a width up to  $60^\circ$  with errors not more than 1 mm and 0.0001" respectively. Not only are the solutions simpler, but computer use is more effective. In the direct problem it is necessary to compute the rectangular coordinates  $x, y$ , the convergence of meridians  $\gamma$  and the image scale  $m$  in the geographic coordinates  $\varphi, \lambda$ ; in the inverse problem  $\varphi, \lambda, \gamma, m$  are computed using  $x, y$ . Using the derived recurrent formulas FORTRAN IV language was used in writing programs for solving the main and inverse main geodetic problems in a rectangular coordinate system in a Gauss projection. In actuality, there is only rare need for computing rectangular and geodetic coordinates with an accuracy of 1 mm and 0.0001". Therefore, any reduction in requirements on the accuracy of computation of coordinates will make it possible to solve the problem in still wider zones. Tables 3; references: 3 Russian.

[86-5303]

UDC 528.27.063

#### GRAVITY COMPUTATIONS AT LOW ALTITUDES

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 1, Jan 84 pp 6-8

BROVAR, V. V. and TADZHIDINOV, Kh. G.

[Abstract] In computing gravity anomalies at altitudes of hundreds of kilometers or greater it is customary to use a model of the earth's potential in the form of an expansion in spherical function. At lesser altitudes a surface gravity survey under the particular point is also used. Gravity, however, must

sometimes be determined at altitudes of tens of kilometers or less in the absence of a gravity survey in the region. The following procedure is used under these conditions: gravity is measured at the surface and it is reduced upward using the vertical gravity gradient  $\partial^2 U / \partial r^2$  of the model field. The accuracy of this reduction decreases with altitude and its critical value must be computed. Using the potential  $U(r, \varphi, \lambda)$  of the model field it is possible to obtain the acceleration of free falling. The measured  $g_0$  value is reduced to the altitude  $H$  using the Lagrange formula. Proceeding along these lines, a formula is derived for the critical altitude  $h$ . The solution will be unstable because the derivatives are dependent on local peculiarities of the anomalous field. A statistically more valid solution can be obtained by replacing the real derivatives with their dispersions. The dispersion of the first derivative is denoted  $G^2(H)$  and the dispersion of the second derivative is designated  $E^2(H)$ . Then a more effective formula is obtained for  $h$ . The critical altitude  $h$  can also be determined graphically. The problem is therefore essentially reduced to computing the dispersion of the first radial derivative and the dispersion of the second derivative at different altitudes  $H$ . The problems involved in computing  $G^2(H)$  and  $E^2(H)$  are discussed. Tables 2; references: 2 Russian. [86-5303]

UDC 550.384.6

#### NORMAL MAGNETIC FIELD MAPS FOR CAUCASUS REGION FOR EPOCH 1980

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR: NAUKI O ZEMLI in Russian  
Vol 36, No 6, Nov-Dec 83 (manuscript received 13 Jun 83) pp 89-91

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[Abstract] In an earlier article (IZVESTIYA AN ArmSSR: NAUKA O ZEMLE, No 3, 1975) O. G. Ovsepyan demonstrated the possibility of constructing the qualitative normal field of the total vector modulus  $T$  and its components on the basis of correction of a global analytical model and constructed maps of the territory of the Caucasus for the epoch 1970. Since the magnetic field does not remain constant, for constructing maps for 1975 it was necessary to know the secular variation. An analytical representation of the secular variation was presented by O. G. Ovsepyan, et al. in ISSLEDOVANIYE PROSTRANSTVENNO-VREMENNOY STRUKTURY GEOMAGNITNOGO POLYA, Nauka, Moscow, 1977. Representation of the field and secular variation by a polynomial greatly simplified the problem of reduction to a new epoch and prediction. Using data from repeated observation points (ROP) it is possible to find the dependence of the coefficients of a polynomial approximating secular variation on time, extrapolate this dependence to a five-year interval and using this dependence reduce the coefficients approximating the field to a new epoch. This was the basis for reduction of the  $T$  maps for the epoch 1970 to 1975 using newly obtained information and the prediction for 1980. The proposed method is applicable for constructing maps of any component provided that in the considered territory there

is an observatory and several repeated measurement points for which there is information on field change in vector form. A special program was prepared for computing geomagnetic field components using the MAGSAT 6/80 model and component maps for the normal field were plotted for the Caucasus region (Figs. 1, 2, 3 in the text). Data from repeated measurement points made it possible to evaluate two maps plotted by different methods. They are both found to be entirely adequate. Figures 3; references: 3 Russian.  
[93-5303]

UDC 550.831

SOLUTION OF DIRECT THREE-DIMENSIONAL PROBLEMS IN GRAVIMETRY AND MAGNETOMETRY WITH ARBITRARY CONTINUOUS LAWS OF DENSITY AND MAGNETIZATION DISTRIBUTION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 9, Sep 83  
(manuscript received 29 Sep 82) pp 57-74

STRAKHOV, V. N. and SHULAIYA, T. V., Institute of Physics of Earth imeni O. Yu. Shmidt, USSR Academy of Sciences; Geophysical Institute, Georgian Academy of Sciences

[Abstract] There has been an obvious practical need for mathematical support in solving direct three-dimensional problems in gravimetry and magnetometry for complex bodies with arbitrary continuous laws of distribution of density and magnetization. The authors are not concerned with the writing of individual programs (such as for computing the  $\Delta g$  or  $\Delta Z$  field for some narrow class of laws of distribution of density or magnetization), but instead propose the forming of an archives or system of programs for computing a large set of elements of external fields from complex bodies with a virtually arbitrary distribution of sources: for the gravity field it is necessary to have programs for computing potential and its first and second derivatives in coordinates, whereas for the magnetic field it is necessary to have programs for computing potential, the first derivatives in coordinates and the  $T$  and  $\Delta T$  fields. The archives must be constructed from programs of the same type which can be assembled from individual modules. Numerical algorithms are given in this article which make a major contribution to solution of this problem. The effectiveness of this work is illustrated in a number of model examples. The proposed programs, suitable for use with YeS computers, are recommended for practical use. Figures 2, tables 4; references: 19 Russian.  
[73-5303]

UDC 550.344.094.4

## INTERFERING ELASTIC WAVE COMPONENTS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 9, Sep 83  
(manuscript received 7 Aug 81) pp 51-56

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[Abstract] In a homogeneous isotropic elastic medium plane waves can be propagated with the velocities  $a = \sqrt{(\lambda + 2\mu)/\rho}$  and  $b = \sqrt{\mu/\rho}$ , where  $\lambda$ ,  $\mu$  and  $\rho$  are Lamé parameters and density; the first corresponds to longitudinal polarization and the second to transverse polarization. The ray method makes it possible to construct a high-frequency analogue of a plane wave in a smoothly inhomogeneous medium. High-frequency perturbations, traveling with the velocities  $a(x)$  and  $b(x)$ , are polarized primarily the same as in a homogeneous medium, but also have weaker components, transverse and longitudinal, called interfering components. However, the formulas for these components have been unwieldy. In order to simplify this problem the author has derived and discusses more convenient formulas for the interfering components of non-stationary modulated oscillations. In the discussion it is made clear that the relative role of the interfering components is determined not only by the kinematics and dynamics of the problem (the geometry of the rays and the diagrams of the sources). The interfering components have a lower frequency. These interfering components of longitudinal and transverse waves in certain cases should be significant in seismic investigations. References: 4 Russian. [73-5303]

UDC 550.344.094.4

## METHOD FOR SUMMING GAUSSIAN BEAMS IN ISOTROPIC ELASTICITY THEORY

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 9, Sep 83  
(manuscript received 28 Jun 82) pp 39-50

POPOV, M. M., Leningrad Division, Mathematics Institute imeni V. A. Steklov, USSR Academy of Sciences

[Abstract] The summing of Gaussian beams method has been successfully used in computing scalar wave fields in a high-frequency approximation both in regions with regular behavior of the rays and on different caustics. This method can be used also in isotropic elasticity theory (Gaussian beams for such equations were constructed by N. Ya. Kirpichnikova in TRUDY MIAN, Vol 115, pp 103-113, 1971). This article describes a method for the summing of Gaussian beams for the equations of isotropic elasticity theory. The essence of the method, as for a scalar wave field, is as follows: a "fan" of rays, a set of rays passing in some neighborhood of  $M$ , is constructed near an observation point  $M$ ; a Gaussian beam is constructed for each ray of the "fan"; the contributions from the Gaussian beams along all the rays of the "fan" are

summed for computing the field at the point M (each Gaussian beam is assumed to have some amplitude determined by the source which generates the ray field). The computation algorithm will remain the same whether M is in the region of regularity of the field of rays or on a caustic. In the case of elasticity equations the Gaussian beam is a vector and rays corresponding to both the longitudinal and transverse velocities fall in the neighborhood of the point M, leading to two "fans" of rays. Although these circumstances do not cause great difficulties, they complicate the algorithm for computing the wave field in comparison with a scalar case and involve a greater volume of computations. This article fully describes a scheme for the construction of Gaussian beams and their reflection (refraction) at an interface and gives formulas for the initial amplitudes generated by point sources (centers of rotation and expansion). Figures 1; references 13: 11 Russian, 2 Western.  
[73-5303]

UDC 551.79:551.24(73)

#### EARTHQUAKE FOCAL MECHANISMS AND MORPHOSTRUCTURE OF ALTAY-SAYAN REGION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 9, Sep 83  
(manuscript received 3 Dec 81) pp 22-38

RASTVOROVA, V. A. and TSIBUL'CHIK, I. D., Institute of Physics of Earth imeni O. Yu. Shmidt, USSR Academy of Sciences; Institute of Geology and Geophysics, Siberian Department, USSR Academy of Sciences

[Abstract] The focal mechanisms of earthquakes in the Altay-Sayan region were compared with the complex block morphostructure of the area. It was found that the small rises situated amidst the mountains that had earlier been identified as remnants of ancient relief are in actuality block-horsts bounded by tectonic scarps. The broadened reaches of river valleys in actuality are grabens which intersect mountain uplifts. These intramontane depressions are formed in sectors of dilatation and compression of the upper part of the crust where the grabens have a structure of the ramp type. The foci of earthquakes with  $K = 9-13$  occur along faults bounding high-order morphostructures (horsts and grabens with linear dimensions up to 10-15 km). The foci of strong earthquakes ( $K > 14$ ) arise in zones of deep and intersecting faults within which small horsts and grabens are formed. Most of the earthquake foci are characterized by faults with steep dips, although there are fracture planes with a small dip. In some cases there is a good correlation of the fracture planes at the focus and surface faults. Therefore it is possible that in the case of a strong earthquake the activation of one fault caused activation of another, outpacing it, and movement occurred almost simultaneously along the two fractures. The relationship of the vertical and horizontal components of movement of the blocks is dependent on their position within large morphostructures. For blocks situated in the central parts of uplifts and depressions there is a predominance of the vertical component, whereas for those situated along their periphery it is the horizontal component which predominates. Figures 7, tables 4; references: 24 Russian.

[73-5303]

GRAVITY FIELD RESPONSE TO ELASTIC DEFORMATIONS OF EARTH

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 9, Sep 83  
(manuscript received 1 Nov 82) pp 3-21

MOLODENSKIY, S. M., Institute of Physics of Earth imeni O. Yu. Shmidt, USSR  
Academy of Sciences

[Abstract] The results obtained by J. B. Walsh and J. R. Rice ("Local Changes in Gravity Resulting from Deformations," JGR, Vol 84, No B1, pp 165-170, 1979) are generalized for a three-dimensional case of a fault with an arbitrary orientation of the Burgers vector. There is a full examination of the theory of temporal changes in the gravity field accompanying local and global elastic deformations caused by a source of the general type. In the examination of gravity field changes accompanying local deformations the author used the approximation of a homogeneous non-self-gravitating half-space. Also examined are models of a point source of shear stresses of the dipole type with an arbitrary orientation of the axes of the main stresses, a three-dimensional model of a tectonic fault with an arbitrary orientation of the Burgers vector and very simple models of the post-glacial uplifting of Fennoscandia. Self-gravitation, the earth's inhomogeneity and sphericity and relaxation of shear stresses are taken into account in computing the gravity field change of the real earth accompanying thermoelastic deformations. The correlations between Love numbers determining the gravity field change accompanying elastic deformations of the tidal type are found. Next it is demonstrated that with extremely broad assumptions concerning the source of deformations the gravity field changes will correlate closely with vertical displacement of the observation point. The computations presented here reveal that in regions of maximum deformations the ratio of the gravity change to vertical displacement of the observation point in all cases is about 0.1-0.3 mgal/m. Uplifting is always accompanied by a gravity decrease. The expressions derived here make it possible to determine changes in gravity and vertical movements in the neighborhood of tectonic faults and post-glacial uplifts and also in connection with thermoelastic deformations and can be used in the interpretation of geodetic and gravimetric data. Figures 1, tables 1; references 21: 7 Russian, 14 Western.

[73-5303]

MOTION OF VIRTUAL GEOMAGNETIC POLE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 2, Feb 84  
(manuscript received 27 Jul 82) pp 41-50

BURLATSKAYA, S. P., Institute of Physics of Earth imeni O. Yu. Shmidt,  
USSR Academy of Sciences

[Abstract] The author has used world archeomagnetic determinations of the angular elements (declination and inclination) of the geomagnetic field in plotting the trajectories of the virtual geomagnetic pole for individual territories on the earth's surface. The investigation was made using pertinent data on declination and inclination in a catalogue prepared by the author and I. Ye. Nachasova (ARKHEOMAGNITNYYE OPREDELENIYA ELEMENTOV GEOMAGNITNOGO POLYA. MATERIALY MIROVOGO TSENTRA DANNYKH B, Moscow, VINITI, 1977). It was found that the position of the virtual geomagnetic pole was usually in the limits of 10-20° from the north geographic pole. The trajectories of wandering of the pole during the last 2,000 years reveal a complex looplike motion. As indicated in a whole series of figures, the movement reveals the global character of changes in the dipole part of the field. This change was manifested in a rotation of the virtual geomagnetic pole about the geographic pole in a counter-clockwise direction in a spiral with slow approach to the latter. The plotted data reveal variations with a duration of 3,000-4,000 years and 1,200 years, on which are superposed variations of the regional part of the field with a duration of 300-600 years. In actuality, during the last approximately 10,000 years the structure of the geomagnetic field in the first approximation corresponds to a dipole law. The deviation from an axial dipole is in the range 10-20°. The nondipole part of the field is expressed by regional variations with a duration of 300-600 years. Figures 8; references 19: 8 Russian, 11 Western.

[100-5303]

RELATIONSHIP BETWEEN RESIDUAL DISPLACEMENTS, STRAINS AND TILTS OF EARTH'S SURFACE AND EARTHQUAKE FOCUS CHARACTERISTICS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 2, Feb 84  
(manuscript received 7 Jul 83) pp 27-33

VOYEVODA, O. D., Institute of Physics of Earth imeni O. Yu. Shmidt, USSR Academy of Sciences

[Abstract] In many cases it is necessary to know the relationship between displacements of the earth's crust and the characteristics of faults forming at the foci of not very strong earthquakes. Such faults are usually buried and the configuration of their surfaces cannot be determined experimentally. Moreover, the concept of fracturing the continuity of material in the earth's deep layers by a plane Volterra dislocation, used by many authors, cannot be

regarded as all-inclusive. The author therefore has further explored the problem of the relationship between displacements of the earth's crust and the characteristics of faults of different configuration and physical nature, finding this relationship within the framework of a model three-dimensional problem of equilibrium of a strained elastic homogeneous isotropic half-space with dislocations. It is postulated that faults are formed at earthquake foci after the process of dynamic destruction of the material in the deep layers has been completed. It is shown that residual displacements, strains and tilts of the earth's surface can be measured by strain gages and tiltmeters and this affords a possibility for determining the components of the tensor of seismic moment of an earthquake focus from the readings of these instruments. In this article, within the framework of the adopted crustal model, the author theoretically demonstrates the relationship between residual displacements, strains and tilts of the earth's surface and the components of the tensor of the seismic moment of an earthquake focus and the coordinates of its hypocenter. The expressions derived for this purpose can be used in evaluating modern crustal movements caused by seismicity and for determining the components of the tensor of the seismic moment of an earthquake focus on the basis of experimentally measured residual displacements, strains and tilts of the earth's surface. Figures 3; references 15: 7 Russian, 8 Western.

[100-5303]

UDC 539.4.015

#### SIZE DISTRIBUTION OF FRAGMENTS FORMING DURING SOLID BODY DESTRUCTION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 2, Feb 84  
(manuscript received 26 Jan 83) pp 16-26

KUZNETSOV, V. M. and LIVSHITS, L. D., Institute of Physics of Earth imeni O. Yu. Schmidt, USSR Academy of Sciences

[Abstract] A probabilistic approach is given for solving the problem of fragmentation accompanying the destruction of brittle solid bodies. The authors examine some laws pertinent to the size distribution of fragments. Experiments were carried out to clarify the influence of deformation and size of samples on the type and parameters of the distribution of fragments. The first series of experiments was with cubic samples of concrete subjected to destruction under uniaxial quasistatic compression. These experiments were to study the scale factor, to ascertain how the general picture of destruction and the mean size of the forming piece changes with a substantial change in the size of the sample and with all other parameters of the process. This involved blocks measuring 55 x 55 x 65 cm and smaller samples measuring 3.8 x 3.8 x 4.8 cm. The second series involved a determination of the granulometric composition of the pieces forming during the axial compression of samples in the form of disks with a diameter of 60 mm and a thickness of 20 mm. The samples were prepared from a mixture of quartz sand and cement. It was found that the degree of deformation exerts a considerable influence on the size of the fragments. In the case of quasistatic loading the granulometric composition is not clearly related to the initial concentration of the inhomogeneities

in the material and to a high degree is governed by its strength. With axial compression of samples differing in volume by a factor of approximately  $10^4$  there is a similarity of the fragments not only with respect to shape, but also their size distribution. Figures 6; tables 2; references 21: 19 Russian, 2 Western.

[100-5303]

UDC 550.34.01

## CHARACTERISTIC ROCK DIMENSIONS AND HIERARCHICAL PROPERTIES OF SEISMICITY

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 2, Feb 84  
(manuscript received 17 May 83) pp 3-15

SADOVSKIY, M. A., GOLUBEVA, T. V., PISARENKO, V. F. and SHNIRMAN, M. G.,  
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[Abstract] Rock is essentially inhomogeneous and consists of an entire hierarchy of inhomogeneities of different scales. This principle can be extended much farther in the geophysical realm. In particular, the seismic process is very closely related to the structure of medium inhomogeneities. In this article the authors investigate some properties of seismicity precisely from this point of view. It is shown that the seismic process manifests the characteristic properties of a hierarchical system with respect to space and energy distribution. Study of these properties required the introduction of some new characteristics not used earlier in investigating seismicity. Use was made of the fractals concept developed by B. B. Mandelbrot and the clusters concept formulated by T. L. Chelidze. Data were drawn from the Gutenberg-Richter catalogue and a special catalog for the Nurek, Tajikistan region. Since earthquakes usually occur at different depths, not at the surface, it was felt better to use hypocenters rather than epicenters in characterizing seismicity; there is a strong dependence of the distribution of hypocenters on depth. The depth distribution of hypocenter coordinates is evidently unrelated to the surface distribution of coordinates. In the future it is necessary to examine focal depth and study the hierarchical character of seismicity using three-dimensional cells. In addition to the space coordinates, the time coordinate should be investigated, thereby making possible a study of the hierarchical properties of seismicity in space-time cells. The seismic process also has hierarchical properties in time: earthquakes are time-grouped in clusters having a hierarchical character. The hierarchical principle may well be applicable to geological structures on the earth's surface, such as to lineaments of different categories. It is suggested that a fully adequate statistical model of the stationary seismic process could be developed on the hierarchical principle. Figures 9, tables 6; references 9: 5 Russian, 4 Western.

[100-5303]

UDC 550.3+550.4

## ADIABATIC STRUCTURE IN MANTLE TRANSITION ZONE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 274, No 5, Feb 84  
(manuscript received 28 Jul 83) pp 1064-1070

TRUSINOVSKIY, L. M., KUSKOV, O. L. and KHITAROV, N. I., corresponding member,  
USSR Academy of Sciences

[Abstract] A study was made of adiabatic structure in the neighborhood of zones of localization of chemical and phase transformations where the temperature gradient can exceed the mean value by tens of times due to the existence of concentrated heat sources. If dissipation caused by viscosity, thermal conductivity and some other factors are neglected the problem of constructing the adiabat is reduced to the purely thermodynamic problem of computing the isentrope in P-T coordinates, which is easily transformed into the geotherm  $T(r)$  by means of the known dependence  $P(r)$ . The authors have solved this problem for the general case of monovariant transformations between pure phases and divariant transformations in binary solutions and the results are used in modeling the structure of the adiabat in the mantle transition zone. Section 1 is devoted to the monovariant transformation. Section 2 is devoted to divariant equilibrium fields on the phase diagram. Section 3 illustrates monovariant transformations in the example of reactions in the binary system  $MgO-SiO_2$ , which is regarded as fundamental in modeling the phase composition of the mantle transition zone. Section 4 examines a part of the phase diagram for the  $MgO-SiO_2$  system, evaluating the possibility of formation of ferromagnesian solid solutions. The study made it possible to trace the behavior of a geotherm in the mantle transition zone and changes in mineral composition in this region in the process of evolution of the mantle and to clarify the local role of chemical energy sources in formation of the temperature profile. Examples are cited demonstrating the effectiveness of the thermodynamic approach to modeling of the fine structure of the mantle transition zone. Figures 2; tables 1; references 14: 11 Russian, 3 Western.  
[96-5303]

UDC 550.837

## DEEP ELECTRIC SECTION OF BASEMENT ACCORDING TO RESULTS OF MHD SOUNDINGS ON KOLA PENINSULA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 274, No 5, Feb 84  
(manuscript received 5 Sep 83) pp 1061-1064

VELIKHOV, Ye. P., academician, ZHUKOV, B. P., GORBUNOV, G. I., VOLKOV, Yu. M. (deceased), ZHAMALETDINOV, A. A., LISIN, A. S., TOKAREV, A. D., KUKSA, Yu. I., KIRILLOV, S. K. and POLTANOV, A. Ye., Geological Institute, Kola Affiliate, USSR Academy of Sciences, Apatity

[Abstract] Implementation of electromagnetic soundings on crystalline shields is highly important in studying the deep electric section of the crust and

upper mantle. In making such an investigation a powerful artificial field was created in the northern part of the Kola Peninsula by the "Khibiny" MHD (magnetohydrodynamic) generator. This makes it possible to excite an electromagnetic field with a magnetic moment up to  $10^{14}$  A·m<sup>2</sup> and with a current duration up to 7 sec. The results of this work make it possible to form a new idea concerning the nature and structure of crustal conductivity over the area of the Baltic shield. It was found that there is a two-level structure of the basement with respect to its electrical properties. The upper level consists of extensive conducting blocks with an area of tens of thousands of square kilometers. Detailed studies of structure of the blocks were made at distances as great as 300 km from the generator and it was found that these blocks have a relatively shallow depth, several tens of kilometers, and are related to structures of Proterozoic and Upper Archean age. This indicates their spatial and genetic relationship to the upper, supracrustal layer of the earth's crust formed as a result of prolonged accumulation of the products of volcanic and sedimentary activity and their subsequent metamorphism. The lower electric level consists of relatively homogeneous poorly conducting blocks. The lower-level blocks can be regarded as the most favorable sectors for studying the "normal" deep geoelectric section characterizing the properties of a spherically symmetric earth. The results of MHD sounding for the territory of the Kola Peninsula were used in constructing a map of the longitudinal conductivity S of the upper part of the crust. The nature of change of S indicates a gradual increase in resistivity with depth attributable to closing of fractures and decrease in the content of pore water. Future objectives of such work are outlined. Figures 4; references 10: 9 Russian, 1 Western.

[96-5303]

UDC 550.831

#### GRAVITATIONAL EFFECTS ACCOMPANYING ONSET OF PUMPING OF GAS IN UNDERGROUND RESERVOIR

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 4: GEOLOGIYA in Russian No 1, Jan-Feb 84 (manuscript received 22 Jun 83) pp 100-101

BELYAYEV, A. S., Moscow University

[Abstract] The Kasimovskoye underground gas reservoir was created in an anticlinal structure, the cap being a clayey stratum with a thickness of several tens of meters and the above-lying section of Paleozoic deposits being represented primarily by calcareous rocks. Gravimetric studies made during 1976-1983 provide data on different stages in operation of this underground reservoir. Immediately after the beginning (April 1978) of input of gas there was registry of unusual manifestations of strong change of the gravity field. In creating a model for explaining the gravitational effects observed over the reservoir it was necessary to take the following spatial and temporal phenomena into account: the clear correlation between gravity variations and onset of pumping with the setting in of an excess pressure of about 30 atm; rapid reaction of the gravity field with the appearance of strong positive variations (amplitude up to 0.15 mgal) already in the first weeks after onset of operation; a great area of

manifestation of gravity variations (about 160 km<sup>2</sup>); some stabilization of gravity variations after 2-3 months; irreversibility of the process, since after cessation of the technogenic effect the gravity field does not return to the initial level; absence of a dependence of gravity variations on the volume of pumped gas. The most intensive manifestation of gravitational effects corresponds to an insignificant gas volume (about 50 million m<sup>3</sup>). The detected gravity field changes are unrelated to the replacement of water by gas, but occur as a result of density changes in the entire rock stratum. The rough model of the physical processes transpiring in the medium during the pumping of gas explains the gravity variations. Positive variations correspond to zones of compression and negative zones correspond to zones of rock dilatation. Even an insignificant increase in density results in anomalies of tens of microgal. Rock deformations occur in accordance with the geological inhomogeneity of the structure and therefore the observed variations contain useful information on the geological structure of the medium. Predictions of gas migration in this reservoir on the basis of gravimetric data have been confirmed by logging and the drilling of additional boreholes. Figures 1; references: 2 Russian.

[92-5303]

UDC 551.242.4

## TWO TYPES OF CONTINENTAL BREAKUP

Moscow GEOTEKTONIKA in Russian № 2, Mar-Apr 84 (manuscript received 6 May 83)  
pp 23-36

KAZ'MIN, V. G., Institute of Oceanography imeni P. P. Shirshov, USSR Academy of Sciences

[Abstract] The process of breakup of a continental platform with the formation of young oceans remains largely unclear, whether the breakup results from local, autonomous factors such as the ascent of a convective flow, or whether it occurs under the influence of regional stresses applied to the lithospheric plate or system of plates. In recent years tremendous amounts of geological-geophysical material have been accumulated allowing, if not the solution of these problems, at least a significant narrowing of the range of research. This refers particularly to data on the formation and development of the passive margins accumulated during the scientific and prospecting drilling in the oceans. The detailed histories thus produced have indicated that there are two types of rifts: 1) those formed by "free" floating of the fragments of large continents and 2) those formed under conditions of continental collision. In both cases extension is accompanied by passive rising of the asthenosphere, floating of the anomalous mantle and its accumulation in the base of the crust. Volcanism in rifts of the first type occurs with subsidence, in the second type both with subsidence and with upthrust. The extensions creating rifts are regional in nature. Their general cause is not precisely known although they are probably created by convective currents in the asthenosphere. Figures 6; references 60: 20 Russian, 40 Western.

[133-6508]

UDC 550.383.348

SPECIFICS OF DEVELOPMENT OF LONG-TERM VARIATIONS IN ANOMALOUS GEOMAGNETIC FIELD ON CRIMEAN PENINSULA

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 2, Mar-Apr 84  
(manuscript received 16 Aug 83) pp 74-83

ZAVOYSKAYA, I. N., Institute of Geophysics, Ukrainian Academy of Sciences, Kiev

[Abstract] Variations in the anomalous geomagnetic field are essentially a response to some secondary electromagnetic or mechanical effect. In 1976, 1977 and 1981, the author's institute performed absolute surveys of  $|T|$ ,  $H$  and  $D$  at 106 locations on the Crimean peninsula. Using data from previous surveys, the author constructed series of field increments since 1900 to reveal possible local peculiarities in the geomagnetic variations. Unambiguous identification of periods of all components in the main geomagnetic field and the difference values of these components were obtained, indicating an induction nature for the high-frequency oscillations of the anomalous geomagnetic field. It was found that areas of response to secondary effects and increments in the geomagnetic field have remained constant over several decades. The submeridional division of the Crimean Peninsula into western and eastern portions observed in certain other geophysical data is also observed in the geomagnetic field data. Figures 5; references 11: 9 Russian, 2 Western.  
[116-6508]

UDC 552.08:53

SOME SPECIFICS OF INFLUENCE OF PORE PRESSURE ON PHYSICAL PROPERTIES OF DEFORMABLE ROCKS

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 2, Mar-Apr 84  
(manuscript received 14 Mar 83) pp 38-42

SOBOLEV, G. A., STAKHOVSKAYA, Z. I. and MIKAYELYAN, A. O., Institute of Earth Physics, Moscow

[Abstract] A study is made of a range of problems related to experimental study of the physical and mechanical properties of limestones from the region of the Ingura hydroelectric powerplant under hydrostatic pore pressure with additional axial pressure. The purpose of the work was to estimate the significance and effect of pore pressure on physical properties in rocks as a function of the stressed state under conditions of hydrostatic pressure and hydrostatic pressure with additional axial loading. The P wave velocity, resistivity and longitudinal deformation were measured under pressure with specimens which had been carefully dried and saturated under vacuum conditions with a 2 n solution of NaCl. Cyclical variations of pore pressure were found to cause compaction of the rock. Cyclical variations of pore pressure under complex stress conditions facilitate fracture and strength loss of the rock.

There was a direct correlation between the velocity of P waves and electrical resistivity under the experimental conditions, resistivity being the most sensitive index of changes in pore pressure. Changes in elastic wave velocity and resistivity can be used to indicate the state of a rock mass and estimate seismic danger near hydraulic structures in which cyclical variations in pore pressure occur. Figures 3; references: 6 Russian.  
[116-6508]

UDC 551.241:550.834.3(574)

#### SOME GEOLOGICAL-GEOPHYSICAL PARAMETERS OF LITHOSPHERE IN KAZAKHSTAN

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR in Russian No 2, Mar-Apr 84  
pp 30-40

GOL'DSHMIDT, V. I., Kazakh Affiliate, All-Union Institute of Prospecting Geophysics, Alma-Ata

[Abstract] This article is dedicated to determination of the thickness of the earth's crust and lithosphere, as well as the temperature conditions of the lithosphere in the territory of Kazakhstan by a method which uses a map of the depth of the M surface and a diagram of the distribution of heat flow over the territory of Kazakhstan. The M surface map was constructed from seismic and seismologic data in the southeast, seismic-gravimetric data over the remainder of Kazakhstan. Primary information on heat flux was obtained by geothermic studies in boreholes and studies of the heat conductivity of rocks in various geotectonic provinces. Figures 5; references: 13 Russian.  
[127-6508]

UDC 550.834.048(574-925.22)

#### IRREGULAR INTERFERENCE WAVES IN THE EASTERN CASPIAN DEPRESSION

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR in Russian No 2, Mar-Apr 84  
pp 70-72

SHIMALIN, A. V., Kazakh Ministry of Geology, Alma-Ata

[Abstract] A study is made of the influence of wind noise on the quality of primary geophysical materials recorded in the eastern Caspian depression. It is found that seismic detectors on the surface or in uncapped boreholes record the maximum microseismic background. Seismic detectors in boreholes at 0.3-2.5 m depth record somewhat less microseismic background when the boreholes are capped. If seismic detectors are buried at a depth of 0.1-1 m, no high frequency microseisms are recorded. Figures 2.  
[127-6508]

UDC 553.41:551.215.4(574.23)

EXPLOSIVE BRECCIA OF VASIL'KOVSKIY DEPOSIT

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR in Russian No 2, Mar-Apr 84  
pp 23-30

DIAROV, A. B., PRONIN, A. P., ABISHEV, V. M., MARCHENKO, L. G., YERMOLIN, V.T., RYABOV, S. N. and POPKOV, V. N., Institute of Geological Sciences imeni K. I. Satpayev, Kazakh Academy of Sciences; Kazakh Institute of Mineral Raw Materials, Alma-Ata; Vasil'kovskiy Mining and Beneficiation Plant, Kazakh Ministry of Nonferrous Metallurgy, Kokchetav

[Abstract] The location and structure of the Vasil'kovskiy Deposit are described. An analysis of the genetic specifics of the gold ore in the ore field indicates the importance of explosive processes in formation of the deposit. "Explosions" related to the Hercynian tectonic-magmatic activation are characteristic features of the deposit. The explosive mechanism was sited in the central portion of the deposit. The apparatus is ellipsoidal in plan, has steeply dipping walls complicated by later disruptions. The apparatus has a complexly differentiated internal structure. The breccia contains smaller fragments of crystallites and granitoids cemented by finely ground material of the same composition. The following are recommended as prospecting criteria for other deposits of the same type: 1) zones of reduced strength of contrast-differentiated domes with multiphase magmatism of homodromal type and evolutionary completeness; 2) areas of spatial combination of intrusive magmatism with subvolcanic magmatism; 3) focusing of eruptive and explosive breccia, with telescoping of the former by the latter with a significant time interruption in explosive processes. Figures 4; references: 4 Russian.  
[127-6508]

UDC 552.1:53:551.217.1(571.649)

PHYSICAL PROPERTIES OF VOLCANOGENIC ROCK IN THE KURIL-KAMCHATKA ISLAND ARC

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 2, Feb 84  
(manuscript received 19 Mar 82) pp 98-108

SHEVCHENKO, Yu. S., Institute of Geology and Geophysics, Siberian Department, USSR Academy of Sciences, Novosibirsk

[Abstract] Results are presented from a study of the magnetic (500 specimens, cappometry) and density (250 specimens, hydrostatic method) properties of volcanogenic rock from the island arc. Relatively dry rock was studied. Indications of change were observed microscopically in many specimens, particularly those from the land. The magnetic properties showed significant fluctuations even in a single group of rocks in terms of basicity. Dispersion of magnetic susceptibility was greater in basic and neutral rock than in acid rock. Effusives from the land had greater magnetic susceptibility in the group of basic rocks and less in rocks with  $SiO_2 > 60\%$  than did specimens from under the

sea. The basic peculiarities of transverse zonality of density properties indicated that the rocks of different zones in the Kuril Islands were unique, with different genetic peculiarities of primary magma and crystallization conditions. Figures 7; references 23: 20 Russian, 3 Western.  
[123-6508]

UDC 550.837.2(571.1/.5-13)

#### REGIONAL NATURAL ELECTRIC FIELDS AND THEIR PROSPECTING SIGNIFICANCE

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 2, Feb 84  
(manuscript received 13 May 83) pp 114-119

GLADKOV, N. A. and BAKSHT, F. B., Siberian Scientific Research Institute of Geology, Geophysics and Mineral Rock Materials

[Abstract] Analysis of results of area surveys of the natural fields and special observations of regional profiles up to 300 km in length across the strike of various geological structures indicated that the regional natural fields have features which are specific for geophysical objects of this rank, including significant dimensions in plan, high field intensities, complexity of internal structure, relationships with geological objects and other geophysical anomalies of the same order. Two types of regional natural fields were found: area fields, occupying tens and hundreds of square kilometers with relatively slow rise in field intensity toward the epicenters; contrast linearly extended fields with intensities up to 1500 mV and sometimes more, which can be traced over strike for tens or hundreds of kilometers, and with a width up to several kilometers. The results indicate the great capability of area regional electric field surveys to assist in the structural-lithological, formational and metallogenic regionalization of folded areas and in the search for various useful minerals. Figures 3; references. 15 Russian.

[123-6508]

UDC [551.7.21.003:543.5](477-7)

#### RESULTS OF LITHOLOGIC AND PHYSICAL-CHEMICAL STUDIES OF MUD VOLCANO SOLID EXUDATES IN KERCH-TAMAN OBLAST

Baku IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA NAUK O ZEMLE in Russian No 2, 1983 pp 74-82

SHIDOV, A. G., SAFAROVA, G. B., ZOKIRABOVA, V. R., POKIDIN, A. K., ALIYEV, I. Dh., MAMEDOVA, G. A., KAMAL'TDINOVA, R. Z. and RASHIDOV, S. A.

[Abstract] Over 400 specimens of solid exudates from mud volcanoes were studied in detail in plane-parallel sections and in immersion preparations, as well as by a combination of thermal, electron-microscope, x-ray structural and other methods. Sandstones, aleurolites, calcareous rocks such as limestones, dolomites, siderites and marls were found, plus some clays. The material

composition of the samples is listed, as well as the results of differential thermal analysis. Minerals found included quartz, hydromica, montmonillonite, chlorite, kaolinite, glauconite and geothite in small quantities. Most specimens contained small quantities of organic matter. Mud volcano breccia is recommended for production of keramzit porous clay filler. Figures 4; references: 4 Russian.

[124-6508]

UDC 550.348.22(479.24):55

ANOMALIES IN MACROSEISMIC FIELDS OF CERTAIN EARTHQUAKES OF AZERBAIJAN AND THEIR GEOLOGIC NATURE

Baku IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA NAUK O ZEMLE in Russian No 2, 1983 pp 110-117

AGAMIRZOYEV, R. A. and AGAMIRZOYEV, S. R.

[Abstract] Analysis and computation of macroseismic fields of earthquakes in Azerbaijan have shown that the mean attenuation is by a factor of 3.5-3.7, although in many fields there are anomalous areas in which the attenuation factors reach 7-9 or drop to 1.2-1.5. In Azerbaijan, both positive and negative anomalies appear in the macroseismic fields of both local and remote earthquakes. Anomalies of macroseismic fields of 22 earthquakes are diagrammed. Comparison of the anomalies with the structure of the Azerbaijan portion of the Caucasus shows that all anomalies are related to fault dislocations. Figures 2: references: 7 Russian.

[124-6508]

UDC 550.380.8

MAGNETOMETER FOR STUDY OF TEMPERATURE VARIATION OF SATURATION MAGNETISM OF ROCK SPECIMENS

Baku IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA NAUK O ZEMLE in Russian No 2, 1983 pp 118-121

ISMAIL-ZADE, T. A. and IBADOV, A. Kh.

[Abstract] The magnetometer developed by the authors is an autocompensation-type vibrational magnetometer. The device is diagrammed and its operation described. The use of the compensation circuit makes the results of measurements independent of the amplitude and frequency of vibrations, thus eliminating errors related to the possible instability of vibration parameters. The autocompensation mode allows continuous recording of magnetism at saturation.

Figure 1; references 8: 6 Russian, 2 Western.

[124-6508]

PHYSICS OF ATMOSPHERE

AEROSOL CHAMBER OF ATMOSPHERIC OPTICS INSTITUTE

Moscow PRAVDA in Russian 5 Mar 84 p 3

[Text] Scientists of the Institute of Atmospheric Optics of the USSR Academy of Sciences' Siberian Branch in Tomsk are studying the propagation of electromagnetic waves of the optical range in the atmosphere of the Earth and the planets. For their successful work, the institute's staff has been awarded a Red Banner Cup by the Communist Party Central Committee, the USSR Council of Ministers, and the Central Committee of the All-Union Leninist Communist Youth League.

(A photograph showed science associates D. Kabanov and V. Pol'kin preparing an experiment in a large aerosol chamber.)

FTD/SNAP  
CSO: 1365/136

CONFERENCE ON NEW EQUIPMENT FOR AIR-POLLUTION MONITORING

Leningrad LENINGRADSKAYA PRAVDA in Russian 20 Mar 84 p 3

[Text] It takes an acoustic locator only the smallest fractions of a second to obtain information on temperature, humidity and pressure at various altitudes in the atmosphere. A few 'shots' at the clouds provide researchers with an accurate picture of the content and distribution of aerosols in the air. The capabilities and prospects of laser probing of the atmosphere are being discussed in a number of the papers and reports which are being presented at the first all-union conference "Methods and Equipment for Monitoring Industrial Emissions and Atmospheric Pollution". Organized jointly by the USSR State Committee on Hydrometeorology and Monitoring of the Natural Environment and the Main Geophysical Observatory imeni Voyeykov, this conference began its work yesterday at the House of Journalists in Leningrad.

FTD/SNAP  
CSO: 1865/136

## SPACECRAFT-AIDED AERIAL STUDIES OF ATMOSPHERE'S ELECTROSTATIC ZONES

Leningrad VECHERNIY LENINGRAD in Russian 17 Jan 84 p 1

[Article by Yu. Trefilov]

[Text] A specialized IL-14 airplane left Rzhevka Airport today on a course for the south. This airplane's crew is headed by V. M. Kashayev, an experienced pilot of the Leningrad Civil Aviation Administration. I asked him a number of questions prior to his departure.

"What is the purpose of your trip?"

"Our laboratory airplane has been chartered by specialists of the Main Geophysical Observatory imeni Voyeykov, with whom our aviators have had ties of creative friendship for many years. On this trip, an experiment will be conducted in flight by a group of the Observatory's science associates headed by A. V. Dagadayev. We are heading for the southern part of our country. In the course of a month, we shall fly over mountain summits of the Caucasus and the Crimea, the Black Sea coast and neighboring areas. The main purpose is to study characteristics of electrostatic zones in the atmosphere. They are very dangerous for air transportation and agriculture."

"Figuratively speaking, you'll be looking for storms in clouds?"

"To a certain extent. Our work will be corrected by data from the Hydro-meteorological Service and earth satellites. On the basis of such studies, scientists are working out recommendations for heightening flight safety in zones of static electricity in the atmosphere."

FTD/SNAP  
CSO: 1865/136

UDC 551.510.535

## EVALUATIONS OF COEFFICIENT OF VERTICAL EXCHANGE IN LOWER THERMOSPHERE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 2, Feb 84 (manuscript received 4 Nov 82, after revision 10 Mar 83)  
pp 206-208

CHUNCHUZOV, Ye. P. and SHAGAYEV, M. V., Institute of Atmospheric Physics,  
USSR Academy of Sciences

[Abstract] Turbulence in the lower thermosphere is generated to a considerable degree by instability and destruction of internal gravity waves. Since the registry of these waves occurs at altitudes near the turbopause, it appears that some characteristics of this layer can be determined. The horizontal gradient was determined by making a series of temperature measurements in three spatially separated regions of the night sky. Temperature was measured at the vertices of a base triangle--at the zenith and at a distance of 156 km to the north and east of it. Temperature was registered simultaneously in two OH bands, making it possible to observe gravity waves at two altitudes. The choice of such a base for registry of the mean gradient precluded the possibility of errors in determining  $G_H$  (horizontal gradient of mean temperature) due to the existence of long-wave and long-period components of meteorological fields at these altitudes. Standard spectral analysis methods were used in discriminating gravity waves from temperature series and their characteristics were determined: period, azimuth of propagation and horizontal phase velocity. Mean temperatures were found at each of the three points. The temperature difference measured at these points sometimes attained 20 K. This considerably exceeded the error in measuring mean temperature, which varied in dependence on the length of the time series but was never more than 0.1 K. Individual values of these gradients obtained in a single night had considerably greater values and an isotropic distribution. This is related to the dissipation of internal gravity waves at the altitudes of the hydroxyl layer. The  $K_z$  (coefficient of vertical turbulent exchange) value agrees well with that obtained by rocket methods. The energy conveyed from internal gravity waves is transformed into heat through turbulence as an intermediate form of movement. As a result of this process a definite vertical temperature gradient  $G_z$  appears at altitudes 90-100 km. In a stationary case turbulent thermal conductivity ensures an outflow of heat to the lower layers. This effect is one of the possible mechanisms of decrease in altitude of the turbopause with an increase in the vertical component of the temperature gradient. Tables 1; references 6: 2 Russian, 4 Western.  
[105-5303]

UDC 551.501.724:551.501.75:551.596.1

SIGNAL POWER DURING RADIOACOUSTIC SOUNDING OF TURBULENT ATMOSPHERE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 2, Feb 84 (manuscript received 29 Dec 82) pp 178-184

KON, A. I., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] A number of authors have made substantial contributions in the study of the influence of atmospheric turbulence on operation of radioacoustic sounding systems, but they have all used an incorrect expression for the longitudinal-transverse coherence function for an acoustic wave in a turbulent medium. An important advance in approach to this problem was made by M. A. Kallistratova and the author in IZV. AN SSSR: FAO, Vol 19, No 12, 1983. In that study a formula was derived for the dependence of the maximum range of sounding in a windless atmosphere on the fundamental parameters of the problem. Now the author has obtained a more complete solution of the problem of the scattering of electromagnetic waves in an extended acoustic train in the presence of turbulence when the diffracting wave beams are formed by antennas of some finite dimensions and the scattered field is analyzed at the output of the receiving antenna. This approach makes it possible to determine the signal power for radioacoustic sounding for a wide range of altitudes of sounding of the turbulent atmosphere and to check the correctness of the qualitative expressions derived in the earlier article. It was possible to clarify the conditions under which in the absence of wind drift the influence of turbulent fluctuations of air density becomes substantial. Formulas are derived which make it possible to compute the mean signal power and the limiting sounding ranges for arbitrary dimensions of the receiving and transmitting antennas. Figures 1; references 13: 8 Russian, 5 Western.

[105-5303]

UDC 551.596:551.576

WELL-DEVELOPED CONVECTIVE CLOUD COVER AS SOURCE OF INTERNAL WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 2, Feb 84 (manuscript received 14 Oct 82, after revision 17 Jun 83)  
pp 173-177

GRACHEV, A. I., LOBACHEVSKIY, L. A., MATVEYEV, L. K., MORDUKHOVICH, M. I. and  
SERGEYENKO, O. S., Institute of Atmospheric Physics

[Abstract] The upper edge of convective cumulus clouds varies vertically with periods in the range 6-25 minutes. The energy of these fluctuations can attain  $3 \cdot 10^{17}$  erg, which is adequate for the generation of internal gravity waves which can be detected in both the surface layer and in the upper layers of the atmosphere. Internal gravity waves have been observed in a network of microbarographs. The wave velocity was about 40 m/sec and the period was 10-15 minutes. The observed waves were monochromatic and were propagated to distances of hundreds of kilometers along the earth's surface. Exploring this

phenomenon in greater depth, the authors investigate the propagation of low-frequency IGW from such sources at the altitude of the ionosphere. The study was based on simultaneous observations of IGW made in the microbarograph network of the Institute of Atmospheric Physics and by quasivertical Doppler sounding of the F region carried out by the Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation. Seven microbarographs were used, the distance between them being 600 m to 70 km. In Doppler sounding the reflected wave was received at a point 80 km from the source. It was found that there is a correlation between surface pressure fluctuations and change in altitude of the point of reflection of radio waves during sounding. Well-developed convective formations can serve as sources of the IGW detectable both in the surface layer and at F-region levels. Cases are possible when such IGW can be received from remote sources both at the earth and in the F-region at horizontal distances not greater than 30 km from the point of their reception at the earth in the presence of waveguide propagation along the earth's surface. Figures 4; references 14: 10 Russian, 4 Western.  
[105-5303]

UDC 551.551.2:551.524.4

#### COMPARISON OF QUALITATIVE AND QUANTITATIVE MEASUREMENTS OF TEMPERATURE TURBULENCE WITH MONOSTATIC SODAR

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 2, Feb 84 (manuscript received 22 Nov 82) pp 162-172

KALLISTRATOVA, M. A., KARYUKIN, G. A., KULICHKOV, S. N., KEDER, J., PETENKO, I. V. and THIEME, N. S., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] The article gives the results of study of temperature turbulence in the lower troposphere carried out during the International Expedition for Instrument Comparison (MESP-81) in 1981 at Tsimlyansk using sodars developed at the Institute of Atmospheric Physics, USSR Academy of Sciences, and the Czechoslovakian Hydrometeorological Institute. The comparison involved the Czechoslovakian "Aerovayronment" (model 300) sodar and two sodars of Soviet design (for vertical and slant sounding). A table gives the technical specifications for these instruments. An important difference between the Czechoslovakian and Soviet instruments was that the first registered a signal proportional to the intensity of the scattered acoustic wave, that is, proportional to  $C_T^2$  (structural characteristic of temperature fluctuations), whereas the latter registered a signal proportional to the amplitude of the scattered signal. All measurements were registered on a facsimile recorder. About 40 profiles were obtained during the daytime hours under convective conditions and about 50 profiles at night during inversions; about 30 were obtained for transitional periods. The facsimile records made possible a precise determination of the blocking layer and type of stratification. The "Aerovayronment" was better in determining the overall dynamics of the vertical distribution of turbulent layers and is convenient for climatological investigations. For

detailed investigations of such atmospheric processes as the intermittence of convective turbulence and the formation of internal gravitational waves it is more convenient to have larger-scale facsimiles with registry of the amplitude rather than the intensity of the echo signal. The quantitative measurements of  $C_T^2$  necessary for computing astroclimatic parameters and for parameterization of the atmospheric boundary layer should always be accompanied by facsimile records which help in the analysis and classification of quantitative measurements. Figures 7; tables 1; references 16: 6 Russian, 10 Western.  
[105-5303]

UDC 551.551.2

#### WIND VELOCITY AND TEMPERATURE PROFILES IN ATMOSPHERIC SURFACE LAYER FOR NEUTRAL AND UNSTABLE STRATIFICATION CONDITIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 20, No 2, Feb 84 (manuscript received 22 Nov 82) pp 151-161

KADER, B. A. and PEREPELKIN, V. G., Institute of Atmospheric Physics, USSR  
Academy of Sciences

[Abstract] An international expedition for instrument comparison (MESP-81-- Mezhdunarodnaya Ekspeditsiya po Sravneniyu Priborov) was carried out during the period 15 June-31 July 1981 at the Tsimlyansk Scientific Station, Institute of Atmospheric Physics. The instruments involved were for measuring atmospheric turbulence. Measurements of the profiles of mean wind velocity  $U(z)$  and temperature  $T(z)$  were made synchronously with fluctuation measurements vertically at six points. Cup anemometers were situated at heights  $z = 1, 2, 4, 8, 16$  and  $32$  m and standard platinum resistance thermometers were displaced upward  $0.15$  m. A comparison of readings was made periodically in the evening under neutral stratification conditions and with minimum temperature fluctuations. The analysis of measurements of the mean temperature and wind velocity profiles in the surface layer indicated that the well-known free convection laws are not satisfied in the entire surface layer sector situated above the logarithmic sublayer, but only in its lower part. This explains why numerous empirical wind velocity and temperature profiles reported in the literature are not in agreement with the mentioned theoretical laws. The universal expressions given in the literature, frequently used in computing the fluxes of heat and momentum on the basis of gradient measurements, are compared with experimental data. This comparison made it possible to exclude some models quite inconsistent with experimental data. Unfortunately, the spread of experimental data was too great to allow giving preference to any of the available models. Figures 3; tables 2; references 15: 7 Russian, 8 Western.  
[105-5303]

UDC 551.511.32:551.466

HAMILTONIAN REPRESENTATION OF EQUATIONS OF HYDRODYNAMICS AND ITS USE IN  
DESCRIBING WAVE MOVEMENTS IN CURRENTS WITH SHEAR

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
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[Abstract] A study was made of nonlinear wave movements in media with a shear flow. In a linear approximation wave movements in such media exhibit dispersion properties which are physically exceedingly diverse, associated with the shearing factor. These properties, together with nonlinearity, are responsible for a whole series of effects. Here the author develops and applies a Hamiltonian method for analysis of nonlinear phenomena in dispersive media. The first two sections of the article give results of a general nature for media of the hydrodynamic type. Then the author proposes a procedure for a Hamiltonian formulation of the equations of motion fitting the problem. Formulas are derived showing that if the relationships (other equations, in addition to the Euler equation) have a linear functional dependence on hydrodynamic velocity  $v$  the Clebsch representation, establishing a relationship between  $v$  and the canonical variables, can be found in general form. The principal aspects of the formulation are illustrated in the example of a homogeneous incompressible fluid in which there is a current with a shear. In the special case of a semibounded medium and a bilinear flow profile it was possible to find the normal variables of the problem. Then, in a one-dimensional case nonlinear long waves are described by the Benjamin-Ono and Riemann equations. Numerical estimates are given for the characteristic values of the parameters used in modeling the atmospheric boundary layer. References 12: 8 Russian, 4 Western.

[105-5303]

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QUASIGEOSTROPHIC MOVEMENTS IN BAROTROPIC AND BAROCLINIC FLUID

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[Abstract] The authors investigated the dynamics of macroscale movements in a thin layer of fluid on a curved rotating surface in a gravity field. The quasigeostrophic vorticity equation is usually derived within the framework of a set of assumptions (smallness of curvature, scale of vertical movements and deviations from an unperturbed state), but recent investigations have revealed the presence of effects of the soliton type for quasigeostrophic movements not conforming to the standard vorticity equation. For this reason the

authors have worked out a clear classification of quasigeostrophic movements and have thoroughly analyzed the possibility of existence of soliton solutions in individual cases. A nonlinear equation is derived for scales much exceeding the Obukhov radius. This equation allows solutions of the quasisoliton type. A similar equation is derived for the case of a baroclinic atmosphere for scales of movements exceeding the internal Rossby radius. The equations of motion in a quasigeostrophic approximation for a layer of fluid on an arbitrary surface of rotation are analyzed. Thus, it is shown that there are alternative versions of the quasigeostrophic approximation leading to different equations describing movements differing in scales and properties. References 8: 6 Russian, 2 Western.

[105-5303]

ARCTIC AND ANTARCTIC RESEARCH

MI-6 HELICOPTER TRANSPORTS CARGO TO 'SP-27' ARCTIC STATION

Moscow VOZDUSHNYY TRANSPORT in Russian 9 May 84 p 4

[Article by O. Borodin, correspondent (Yakutsk)]

[Excerpt] Helicopter pilots of Yakutia performed this operation in the Arctic. A crew of the Nyurba Aviation Enterprise flew a MI-6 helicopter over a route running from Nyurba to Zhokhova Island via Chokurdakh and then made several flights to the new drifting station "SP-27". Valeriy Ivanovich Vanin, senior navigator of the Nyurba Aviation Enterprise, told our correspondent about the crew's work in the high latitudes.

"A similar flight was made to the 'SP-24' station in 1978. We transported food supplies and equipment to this station's drifting ice floe. This initial flight showed that the MI-6 can be a reliable aid to polar explorers.

"We arrived at Zhokhova Island on April 30 and began flights to 'SP-27' on May 1. A DT-75 tractor was flown to the station on the first trip, and on the next day we began transporting fuel, collapsible shelters and three diesel engines for the station's power plant. We transported as much as 4 tons on a single trip. And we hauled 28 tons of cargo in all to the station with eight trips. The weather favored us and we flew without complications, especially since the helicopter was equipped with extra navigational devices.

"We made our last trip on May 5. And it was then that the Arctic tested our abilities. [On the way back] dense clouds were encountered over the East Siberian Sea, and we had to descend. We flew by instruments only. But this test, too, was passed by the crew with honors. We arrived home in Nyurba on May 6, after 15 hours in the air."

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## OVER-ICE EXPEDITION CHARTS ARCTIC OCEAN FLOOR

Moscow VODNYY TRANSPORT in Russian 20 Mar 84 p 4

[Article by G. Simkin, correspondent (Tiksi)]

[Excerpt] At the end of February, a team of hydrographers from the Tiksi Hydrographic Base left Makar Island in the Laptev Sea and headed for Cape Tuor-Khan. This expedition will travel on tractor-pulled sleds for thousands of kilometers over the ice of the polar sea, making soundings for the purpose of determining the floor relief and depths of the sea. The aim of this important work is to ensure safety of shipping on the Northern Sea Route.

The hydrographers, who are headed by German Zhernov, are proceeding in tacks for distances of three to four kilometers. Changing direction, they sound the sea depth. They drill holes in ice that is many meters thick and measure depths and reliefs of the seabed. Their daily norm is four tacks, or 15-18 kilometers in bitter cold and adverse weather. Results are recorded carefully on a survey sheet. It can accommodate 16,000 depths and 3,000 fixes of position. And so the work goes for days and months on end.

Sheets with data obtained and results of soundings are transmitted to specialists of the hydrographic enterprise, who make corrections in nautical charts. Navigators can thus plot ships' courses more confidently with these charts. They are forewarned of navigational hazards: huge icebergs, and underwater rocks, sand bars and shoals. After the over-ice teams finish their winter work, hydrographic vessels of the Tiksi Hydrographic Base will set to sea in the summer. They will continue soundings for the purpose of better studying sectors of the Laptev and East Siberian Seas and the mouths of Arctic rivers.

"Simply finding hazards on sea routes and entering their coordinates on charts is not enough, however," said Yuriy Ditts, chief engineer of the Tiksi Hydrographic Base. "These hazards still must be marked with beacons, radio beacons, buoys and other markers set in the proper place. Nikolay Mon'ko's team is putting navigational equipment into service and supplying everything necessary for radar systems. One hundred and forty sea markers have been deployed in the zone that we serve: from the mouth of the Olenek River to the mouth of the Indigirka, including the New Siberian Islands."

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ARCTIC GEOLOGICAL-GEOPHYSICAL SURVEY SHIP 'AKADEMIK GOLITSYN'

Moscow PRAVDA in Russian 20 Mar 84 p 3

[Article by A. Khramtsov, correspondent]

[Text] Murmansk, March 19--A motor ship, the "Akademik Golitsyn", has been launched at the shipyard in the Finnish city of Turku.

This vessel, which was built to orders of the Soviet Union, will be added to the fleet of the Murmansk Offshore Oil and Gas Geological-Geophysical Expedition. Geophysical specialists on board the ship will pursue further study of the coastal shelf of arctic seas. The new ship is named for academician B. B. Golitsyn, who was one of the first scientists to begin using seismic methods for studying the Earth's interior.

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## EVACUATION OF 'SP-25' ARCTIC STATION IN PROGRESS

Leningrad LENINGRADSKAYA PRAVDA in Russian 10 Apr 84 p 1

[Article by N. Osipov]

[Text] The scientific station "SP-25", which is drifting in the Arctic, is now located about 500 kilometers from the North Pole.

"Its present drift turned out to be an unusual one," related N. A. Kornilov, deputy director of the Arctic and Antarctic Institute. "Ice conditions in the area of this drift became difficult; breakups of the ice have taken place and cracks have occurred. 'SP-25' has been drifting practically in the same region, which is confined to an area of 150 square kilometers, and it has become essentially a stationary polar station.

"Lately, the station has begun to move slowly in the direction of the Canadian archipelago, which is difficult to reach. It was therefore decided to evacuate 'SP-25'. This work is now being conducted intensively with three airplanes, using a temporary base that has been created on the drifting ice floe."

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COMPREHENSIVE STUDIES OF NORTH ATLANTIC PLANNED FROM SHIP 'SHULEYKIN'

Leningrad LENINGRADSKAYA PRAVDA in Russian 24 Mar 84 p 1

[Article by A. Vorob'yev]

[Text] The "Akademik Shuleykin", a scientific research ship of the Arctic and Antarctic Institute, has set out from Leningrad on a new expeditionary cruise.

During the cruise, research will be conducted in line with the programs "Polyarnyy eksperiment--Sever" and "Razrezy". Their main task is obtaining field data from a large area of the northern part of the Atlantic Ocean, up to the edge of drift ice. For this purpose, a complex of measurements will be undertaken which will include aerometeorological observations, oceanographic surveying of a portion of the Norwegian Sea, hydrochemical and hydrogeological studies, and the deployment of autonomous buoy stations.

Routine synoptic observations will be made, and photographs will be received from artificial earth satellites during the cruise. The expedition's team of scientists is headed by Candidate of Physical-Mathematical Sciences A. P. Nagurnyy.

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## AIRLIFT OPERATIONS FOR CREATION OF 'SP-27' ARCTIC STATION

Moscow VOZDUSHNYY TRANSPORT in Russian 28 Apr 84 p 4

[Article by O. Borodin, correspondent (Cherskiy Settlement)]

[Abstract] The article records comments of Lyubov' Il'inichna Vasyagina, commander of an Il-14 airplane, regarding work which crews of the Kolyma-Indigirka Aviation Enterprise are performing in support of Arctic drifting stations.

Vasyagina gives a brief account of operations for the evacuation of the "SP-25" station, which have been completed. On April 23, her crew made its last flight to this station, which was drifting in the region of the pole of relative inaccessibility. She relates that a search for an ice floe for a new Arctic drifting station, No 27, was pursued simultaneously with these operations. Aerial ice reconnaissance of a vast area in the eastern sector of the Arctic was conducted. On one reconnaissance flight, hydrologist V. Shil'nikov discovered a suitable floe. Equipment, fuel and food supplies are now being transported to this ice floe for the future "SP-27" station. It will be headed by Yu. Tikhonov, who was head of the "SP-22" station.

Vasyagina also reported on the progress of operations for supplying the "SP-26" station, which was set up last year, and for replacing the winter team of specialists at this station. It was planned originally to perform these operations with an AN-12 airplane. A runway for this airplane which was built on the station's ice floe was washed out, however, and the airlift again had to be done with IL-14 airplanes. The replacement of the station's personnel had nearly been completed by May 1, and the transporting of more than 100 tons of cargo to "SP-26" was in progress.

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'LED-2' INSTRUMENT FOR AERIAL MEASUREMENT OF ICE

Moscow SOVETSKAYA ROSSIYA in Russian 25 Apr 84 p 1

[Excerpt] Arctic shipping is in full swing. Nuclear-powered vessels are leading convoys of ships to Dudinka and the Yamal Peninsula. An instrument, the "Led-2", is helping them to forge a path through the ice.

Both seamen and aviators call this instrument a trustworthy friend of polar reconnaissance scouts. It permits the remote determination of the thickness of sea ice from an airplane. Cracks, channels and open water which layers of newly formed ice or new-fallen snow have concealed from visual observation can be found with the instrument.

"These qualities permit the use of the instrument in any Arctic operation for plotting courses for ship convoys," said Yu. Utusikov, chief of the shipping operations headquarters for the western sector of the Arctic.

Ice floes for the drifting scientific station "Severnnyy Polyus-26" were searched with the new instrument. It makes it possible to find ice floes that are safe for airplane landings.

This invention of scientists of the Riga Institute of Civil Aviation Engineers was discussed at a meeting of the presidium of the USSR Academy of Sciences and received high praise. Scientists and operations specialists were unanimous in the opinion that the instrument must be used on sea, air and river routes as a reliable guide for everyone who is exploring the Soviet North in the country's interests.

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